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DISEASES DUE TO PROTOZOAN PARASITES.

LIGNIÈRES (J.). i. **La vaccination des Bovidés contre l'anaplasmose. L'*Anaplasma* inoculé au mouton et à la chèvre s'atténue dans l'organisme de ces espèces animales et leur sang est alors un excellent vaccin pour les Bovidés contre l'anaplasmose la plus grave.**—*Bull. Soc. Path. Exot.* 1919. Dec. Vol. 12. No. 10. pp. 765–774.

ii. **L'isolement et la recherche des *Anaplasma* par l'inoculation du sang suspect au mouton ou à la chèvre.**—*Ibid.* pp. 774–779.

iii. **Sur l'évolution des *Anaplasma* dans le sang des bovidés.**—*Ibid.* 1920. Jan. Vol. 13. No. 1. p. 19.

i. In a previous communication Lignières showed that sheep and goats were susceptible to inoculation with *Anasplasma argentinum*, and that the infection could be transmitted for an apparently indefinite number of times through the bodies of these animals, but the virus was never observed to produce any manifest symptoms or lesions in them. Proof of the maintenance of the parasite in their bodies for some years was easily furnished by the injection of some of their blood into cattle.

Most of the cattle thus inoculated suffered from a severe form of anaplasmosis, but, more rarely, the only symptoms shown were slight fever and the presence of anaplasms in the red corpuscles. Sometimes slight fever only was manifested, lasting a few days, about 30 days after the injection, and there was no loss of condition and no anaplasms visible in the corpuscles. Again, in other animals even fever was altogether absent but it could be shown that the animals had actually been infected, for if they were subsequently inoculated with virulent Anaplasma blood they remained quite unaffected. Moreover, it could be proved that these cattle—which had shown only a slight transient fever—had become infected with the parasite

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and that the organism had regained its original virulence, for if a little of their blood were inoculated into another, susceptible, ox the latter became affected with a severe, sometimes fatal, type of the disease.

The author describes in detail a series of three selected experiments demonstrating the possibility of vaccinating cattle by means of blood from infected sheep (1st and 2nd passages from infected cattle).

In another experiment an ox was vaccinated with an Anaplasma strain maintained for 11 generations in sheep; before this animal was submitted to a test inoculation, its blood was injected into two susceptible cattle, which became severely ill, and one died, of anaplasmosis. The virus was further maintained for a period extending over five years in the bodies of sheep.

Two experiments are described in which goats were used in the same manner as a reservoir for the virus. These animals were found to become infected after intravenous, intramuscular, or subcutaneous injection and the inoculation of their blood into cattle produced as a general rule the same results as in the sheep experiments, and it appeared that their blood was capable of producing an immunity even more readily than the blood of the sheep.

It is highly necessary to exercise a certain amount of discretion in selecting the strain of Anaplasma for vaccinating cattle after transmission through a series of sheep. It was found that some strains became rapidly attenuated whilst others remained virulent for a much longer period, and organisms were found capable of producing a fatal result even after passage through three sheep consecutively. Usually the organism was more readily attenuated when it had been derived from an ox that had recovered some time than when it was taken for injecting the sheep from an ox during the febrile period of the disease. It was also found that if the interval between the injection of the sheep and the abstraction of its blood for inoculation was extended the degree of attenuation was more marked. For example, if the sheep's blood were taken for inoculation after two months it was found to be too virulent whilst if it were taken after 10 months the virus had become attenuated. In order to obtain material for vaccination the author first selects Anaplasma strains of low virulence for sheep inoculation and transmits them from sheep to sheep or from goat to goat, the interval between each sub-inoculation extending up to at least six months. The degree of attenuation of the virus is such that it can be inoculated as a vaccine almost without danger into adult cattle, even highly priced pedigree cattle.

THEILER devised a method of vaccination against *Anaplasma marginale* by submitting the animals beforehand to an injection with a particular type of anaplasm which he discovered and named *A. centrale*. This type of organism was not encountered by Lignières in Argentina and before the method of vaccination described in this paper was adopted he experimented upon the inoculation of calves with blood from cattle that had recovered for a considerable time. Immunity was set up in this manner but very often the reaction was intense and some calves were thereby lost; this method could on no account be adopted as a means of protecting adult cattle. Since December 1916, however, the new method here described has been adopted for vaccinating many hundreds of highly bred cattle, and the accidents arising

therefrom were rare whilst an extremely satisfactory degree of immunity against the natural infection was obtained.

ii. In natural circumstances anaplasmosis is almost always associated with piroplasmosis. Hitherto the author has only once met with the former disease in a pure state and this was in a certain district of Argentina; in this district the cattle were infested with only one species of tick, of the genus Amblyomma.

The separation of the blood parasites causing these two diseases is a matter of considerable difficulty; but, it is highly desirable to obtain each in a state of purity not only in order to study them comparatively but also in order to determine the presence or absence of Anaplasma in cattle in tick-infested districts and thus draw up an epizootiological chart indicating the zones in which the disease caused by this organism is to be found. The attention of local authorities is called to the necessity of such a chart, principally in order that a supply of Anaplasma vaccines may be rendered available only for those zones in which this parasite produces disease.

In view of the results obtained by Lignières in the course of his experiments it is now possible to isolate Anaplasma quite easily from Piroplasma, inasmuch as sheep and goats are susceptible towards the former parasite whilst they are, on the other hand, immune towards the latter. One has thus only to inoculate the blood of an ox containing the mixed infection either intravenously or intramuscularly into a sheep or goat, and although no visible signs of disease are produced in these animals yet if some of their blood is taken on the 30th or 40th day, or, still better, towards the 60th day after the injection and inoculated into a calf or an adult ox this animal subsequently suffers from a pure Anaplasma infection, *i.e.*, if this parasite existed in the suspected blood.

The author again details a number of experiments in support of these assertions.

iii. The author endeavoured to obtain some light upon the evolution of anaplasms in the circulating blood, and with this object in view he took some blood containing very numerous parasites from the jugular vein of cattle affected with a severe form of the pure infection. The blood was defibrinated and distributed in sterile test tubes and then placed in the incubator at 37° C. At the time of bleeding the blood showed after staining with Laveran or Giemsa numerous parasites of the normal type and also very small forms the diameter of which scarcely reached one-third the diameter of the typical forms. On the following day this blood, kept in the incubator, showed the presence of rounded intensely and uniformly stained granules in the parasite, most often four in number, and later these granules became liberated and appeared identical with the minute forms above described as occurring in the fresh corpuscles. Upon daily examination subsequently these changes were found to become rapidly more extensive. They could also be observed when the blood was kept at room temperature but they were then of slower development. It is suggested that these granules may represent the manner in which the anaplasms multiply within the host's body.

[Experiments of a similar kind, upon the "Cultivation of *Anaplasma marginale* in Vitro," have already been described by Veglia (F.) (this *Bulletin*, 1916, Vol. 4, No. 3, p. 93).—Ed.]

BRUMPT (E.). **Transmission de la piroplasmose canine tunisienne par le *Rhipicephalus sanguineus*.** [Transmission of Canine Piroplasmosis of Tunisian Origin by means of the Tick, *R.s.*].—*Bull. Soc. Path. Exot.*, 1919. Dec. Vol. 12. No. 10. pp. 757–764. With 1 text fig.

In the preceding number of this *Bulletin* an abstract was given of the author's researches upon the transmission of canine piroplasmosis (malignant jaundice) in France by means of the tick *Dermacentor reticulatus*. In the present paper the author describes a similar series of experiments upon the transmission of canine piroplasmosis of Tunisian origin by means of the tick *Rhipicephalus sanguineus*.

It was shown by LOUNSBURY (1901) in South Africa that the tick there responsible for the transmission of the disease (viz., *Haemaphysalis leachi*, which changes its host three times in the course of its life cycle) was incapable of transmitting the disease in the larval or nymphal stages and that only the adult female tick was infective. The same author showed in four experiments that neither the larvae nor the nymphs fed on an infected dog could carry on the disease to the succeeding stage. These results were confirmed by Brumpt in his experiments on the transmission of the disease by means of the French tick, and, moreover, it was shown that an infected tick maintained its infectivity even after it had been reared as a larva and as a nymph on immune hosts such as the guinea-pig and hedgehog.

In 1907 CHRISTOPHERS showed that the disease was transmitted in India by means of *R. sanguineus*, and found that the infected adult ticks produced progeny which were not infective in the larval stage but were infective in the following nymphal stage and adult stage. Thus, the hereditary infection of the ticks would not appear to be necessary, as seems to be the case when the vectors are *H. leachi* and *D. reticulatus*, and nymphs fed on an affected dog would be capable of transmitting the disease in the succeeding adult stage, and according to CHRISTOPHERS the nymph appears to be particularly virulent inasmuch as it can transmit the disease after a short incubation period of $3\frac{1}{2}$ days.

Brumpt's experiments were carried out in Paris, and at Sao Paulo, Brazil, where the disease is not known to occur, and his experiments would indicate that the piroplasmosis can only be transmitted by means of the adult female ticks; besides, a dog bitten by 60 adult Rhipicephalus, known to be not infected before they were used for experiment and reared as nymphs on a dog that was severely infected (with a South African strain obtained from NUTTALL), did not become infected with the disease.

The experiments were briefly as follows. About 50 adult female ticks obtained from a dog, brought from Tunis in 1910 and containing piroplasms in its blood, produced some thousands of larvae. These larvae were placed on three dogs, which subsequently did not contract the disease. The nymphs issuing from these larvae were placed on five dogs, from which were obtained a large number of nymphs engorged with blood; none of these dogs became infected. The adult ticks obtained from these nymphs were placed in December, about six weeks after moulting into adults, on a dog but they refused to attach themselves (as was to be expected with this species which hibernates

at this time of the year). The same adults were placed in the following May on two dogs, both of which subsequently became infected and one died, while the other contracted a benign form of the disease.

The hexapod larvae issuing from this new generation of adults which had infected these two dogs were reared on two more dogs, but these dogs did not show any signs of disease subsequently. These larvae gave rise to a large number of nymphs which were placed on another two dogs, but these again did not become infected. However the adult ticks obtained from these nymphs produced the disease after having been placed on a susceptible dog.

In another experiment, which has already been mentioned above about 60 adult ticks which had been previously fed as nymphs on a badly infected dog failed to set up the disease when allowed to bite a susceptible dog. The ticks in this experiment were obtained from adults collected on dogs in Rio de Janeiro.

A large number of nymphs of two French ticks *Ixodes ricinus* and *Haemaphysalis concinna* obtained from females that had been fed upon an infected dog likewise failed to transmit the infection. The question as to why in canine piroplasmosis the adult female ticks are alone infective remains unsolved, and it cannot be explained by any anatomical or biological peculiarity of the tick. It is probable that *P. canis* can only complete its life cycle and give rise to metacyclic forms, still undescribed, in the body fluids of the adult ticks. The piroplasm would thus behave quite differently to the other strains of piroplasms. For example, *P. divergens* of cattle in Europe can be transmitted both by means of the larvae and the nymphs descended from infected females. *P. ovis* is taken up by the larva and the nymph and transmitted by the adult tick. *P. bigeminum* and *P. argentinum* are inoculated by the descendants of infected ticks sometimes in the larval and sometimes in the nymphal stages following, inasmuch as the disease manifests itself in from 12 to 15 days, that is, just before or after the second moult.

In a footnote the author states that canine piroplasmosis due to *P. canis* is unknown in Brazil, but there occurs in that country instead a disease known as *Nambi-uvu*, which is set up by a particular kind of piroplasm, *Rangelia vitali*. This piroplasmosis is probably transmitted to the dog by means of the tick *Amblyomma striatum*.

BRUMPT (E.) **Existence de la Spirochétose des Bovidés au Brésil. Transmission de cette affection par la tique : *Margaropus australis* (Fuller).** [The Existence of Bovine Spirochaetosis in Brazil. Transmission of the Infection by means of the Tick *M.a.*]—*Bull. Soc. Path. Exot.*, 1919. Dec. Vol. 12. No. 10. pp. 748–757. With 1 text fig.

The author describes his discovery of Brazilian spirochaetosis while engaged in France in studying the biology and pathogenicity of cattle ticks originally obtained from Brazil in 1915. These ticks, which had been collected from apparently healthy slaughterhouse cattle, produced thousands of embryos, and when these were placed on a calf they set up a piroplasmosis due to both *Piroplasma bigeminum* and *P. argentinum*.

From this first lot of ticks the author bred nine successive generations on suspectible cattle. Some lots lost their *P. bigeminum* infection at the third generation and their *P. argentinum* infection at the sixth generation. From the first to the seventh generation these ticks, fed upon six different cattle, did not (as far as could be ascertained by a simple direct, but undoubtedly not sufficiently searching, examination) transmit spirochaetosis. Inasmuch as *Sp. theileri* infections, as one knows, run a very benign course it is probable that these cattle were actually infected but, in order to demonstrate this point, it would have been necessary to inoculate their blood into a number of susceptible cattle, and it was not possible to do this.

The larvae born from the female ticks of the seventh generation were reared on a four-year-old Breton cow, which subsequently showed no noteworthy symptom. But the larvae born from the adult ticks collected from this cow were placed upon a ten-year-old Breton cow and they produced in this animal for a period of about 24 hours a *Sp. theileri* infection, which, however, would have been certainly overlooked had the temperature not been regularly taken and a microscopic examination made of the blood. On the 13th day after inoculation the temperature was: 8 a.m. 39·6° C., 2 p.m. 40·5° C., 7 p.m. 40·6° C. (normal temperature 38·5 to 38·8° C.). At 2 p.m. blood examination showed the presence of rare spirochaetes (about 1 after every two or three minutes examination). At 7 p.m. they were rarer (2 or 3 after 1 hour's examination). There were no other symptoms. This cow had a calf at foot, and this calf was inoculated subcutaneously with some blood taken from its mother about a week after the appearance of the spirochaetes. Subsequently, it showed no rise in temperature or spirochaetes in its blood. About three months later a large number of larvae obtained from females collected from the mother was placed on the calf, but no infection resulted, and apparently the calf had become immune.

Morphologically the spirochaete referred to above was identical with *Sp. theileri*. The smallest forms measured about 8μ long and showed 4 spiral turns. The largest measured 19μ long and showed 8 spiral turns. The undulations were pretty regular and the body was uniformly about $\frac{1}{4}$ μ thick and slightly thinner towards both extremities, but sometimes it was thinner towards one extremity only, and it showed no flagella. The width of the spiral in well fixed preparations varied from 1·5 to 2μ.

Theiler and Laveran described forms 30μ long but these authors were able to examine a number of preparations rich in spirochaetes taken from several animals. In some of the cases examined by Theiler the infection was so intense that the parasites numbered six or more per field of the microscope; this author, moreover, pointed out the irregularity in the appearance of the spirochaetes in the blood of the infected animals.

Although *a priori* it would not be possible to assert that bovine spirochaetosis does not occur in France the author believes that the spirochaetal infection discovered above was Brazilian in origin. The existence of bovine spirochaetosis has not hitherto been identified in South America in spite of the numerous blood examinations which have been carried out in Argentina and Brazil. However, in 1915 Crawley (Howard) noted the presence of spirochaetes in the body

of the tick *Margaropus annulatus* and considered that these organisms were probably stages in the life cycle of *Sp. theileri*, and in 1918 whilst these experiments were being carried out by Brumpt in France CLARK (C.) identified spirochaetes in the blood of two cattle in the Panama Region. [The author here seems to have omitted one reference. BLIER in 1915 recorded the presence of spirochaetes in the spleens of cattle suffering from a form of redwater (*Meada de Sangre*) in Chili (see this *Bulletin*, 1916, Vol. 4, No. 3, p. 95.—L'hémoglobinurie bovine du Chili (Maladie à parasites Spirochétiformes)—ED.]) Spirochaetes have not yet been detected in the horse, goat, or sheep in America.

On the other hand, since the discovery of the spirochaete in the ox and in the horse by THEILER (1902 and 1904) and in the sheep by MARTOGLIO and CARPANO, numerous authors have identified these organisms in Africa and in Asia. The method of transmission, by means of ticks (*Margaropus decoloratus*), was established in 1904 by THEILER in the Transvaal and confirmed in Paris by LAVERAN and VALLÉE in 1905. In 1906 THEILER succeeded in transmitting the infection to other cattle and to sheep and noted the mild nature of the disease. DODD (1907) noted the presence of the spirochaete naturally in the horse and transmitted the infection to another horse, and with the blood of this animal he succeeded in infecting a steer, a heifer, and two sheep; a horse and a rabbit inoculated showed no spirochaetes. A point of interest in DODD's experiments was that the two cattle inoculated with the spirochaete of equine origin did not contract the disease under natural circumstances after having been bitten by infected larvae whilst nine control cattle, on the other hand, showed the presence of the organisms. THEILER's, and more especially DODD's work thus goes to show that the parasites *Sp. theileri*, *Sp. equi*, and *Sp. ovina* are identical and therefore the last two names should fall into disuse. The author further discusses the significance of the various points raised in the study of this benign tick infection.

LIM (R. K. S.). **A Parasitic Spiral Organism in the Stomach of the Cat.**—*Parasitology*, 1920. March. Vol. 12. No. 2. pp. 108–112. With 1 plate comprising 5 figs.

While examining sections of an apparently normal stomach of a cat the author discovered clusters of spiral organisms within the lumina of numerous ducts and glands. The presence of these organisms was then ascertained in eight cats, all of which had been in the laboratory for some months. Cats which were killed immediately on admission or which had been isolated were not affected; rabbits kept in adjacent cages were not infected. The stomach was the only organ affected although a few spirochaetes were found within the duodenum close to the pyloric sphincter. Groups of spirochaetes were usually seen within the lumen of the tubules in the middle zone of the mucosa, where the oxyntic cells were most abundant The organisms did not cause any marked change in the histological appearance of the stomach.

The spirochaetes measured from 4 to 8μ in length by ·75 to 1μ in breadth and the thickness of the spiral, which was cylindrical, was from ·25 to ·5μ. The number of spirals in each organism of from 5 to 6μ was 7 to 8, but occasionally as many as 14 spirals were present.

The organisms stained readily with most aniline dyes, slightly with Gram, and bluish with Giemsa. When fresh preparations were examined, with a dark ground illumination, the organisms seemed to be extremely active. All attempts at cultivation failed but it was noted that the organisms could survive at least four days in an acid medium (·02 per cent. HCl). Nothing definite could be stated as to the mode of infection. Fleas were often found in the gastric contents but when specimens of these taken from the body surface were examined nothing was found to indicate that they were the carriers. The food could not be incriminated inasmuch as the same diet was given to the laboratory animals which were found not to be infected.

The author quotes Noguchi, 1915–1916, who refers to the finding by Bell and Roquet of a similar organism in the stomach of a dog. Spiral organisms were also described by Lucet (1910) in a case of gastric enteritis in the dog.

[The author appears to have omitted one recent reference. Kolmer and Wagner found " within the gland follicles of the fundus of the stomach of an apparently quite normal dog a very large number of spirochaetes in pure culture, which apparently produced no visible lesions." These spirochaetes, however, appear to differ from those described by Lim, inasmuch as they were from 10 to 12μ in length by ·25μ in breadth, and always possessed eight spirals, each of which was ·7μ in depth, and they were found exclusively extra-cellular—this *Bulletin*, 1917, Vol. 5, No. 2, p. 95.—Ed.)]

Formad (Robert J.). **Pathology of Dourine with Special Reference to the Microscopic Changes in Nerve Tissues and other Structures.** —*Jl. Agric. Res.*, Washington. 1919. Nov. 1. Vol. 18. No. 3. pp. 145–154.

Within the years 1915–1919 an average of from 45,000 to 55,000 complement fixation tests have been made annually by the United States Bureau of Animal Industry for the diagnosis of dourine. The samples were forwarded from Montana, North Dakota, South Dakota, Nebraska, Wyoming, Arizona, and New Mexico, and especially from the Indian Reservations in these States. Many improvements were made and perfected in the method of performing the complement fixation test with the object of furnishing better means of arriving at a diagnosis, which is the most essential factor in eradicating the disease. Advantage was taken of the opportunities presented for making a study of the microscopic pathology of dourine inasmuch as very little attention has been hitherto paid to this point.

Material for study was taken from several well-developed chronic cases of dourine in horses in which the disease had been recognised clinically and confirmed by the results of the complement fixation test. The animals were subsequently kept under observation for nearly two years until they died, and on post-mortem examination showed lesions of dourine. The author dwells upon the precautions that have to be taken in order to obtain nerve tissues in a fit state for examination, for dissolution of these tissues commences rapidly post-mortem. Of the different fluids adopted for fixation a 4 per cent. solution of formaldehyde was used most often as a preliminary fixative

on account of its great power of penetration and rapid fixation. It had to be followed, however, by other reagents such as Müller's fluid or Zenker's fluid containing chrome salts which bring out more clearly the ganglion cells, neuroglia, and axis cylinder Besides the general nuclear stains for cell protoplasm selective stains were used such as Van Gieson's stain, Nissel's stain, Pal's modification of Weigert's myelin stain, and Marchi's method of staining fatty degeneration in the myelin sheaths.

On account of the fact that dourine is transmitted during the act of coition it would be natural to expect the principal lesions in the genital organs, but in all chronic cases there are to be observed, besides the lesions in the sexual organs, pronounced derangements of peripheral nerves and the central nervous system, manifested by paralysis of nerves and atrophy of various groups of muscles. As trypanosomes can be found neither in the central nerves nor in the peripheral nerves it has to be assumed that the organisms elaborate poisonous products or toxins which are responsible for the lesions. The author leaves out of consideration the nature of the lesions in acute cases as all his observations were confined to chronic cases. The brain, spinal cord, spinal ganglia, and peripheral nerves were the tissues selected for examination. No detailed study of muscles, skin, and genital organs was undertaken.

The author summarises his observations as follows :—

"The microscopic examination of the brain showed no appreciable changes in the nerve cells, the supporting tissue, or in the blood vessels. In the cervical, anterior, and middle dorsal portions of the spinal cord lesions could not be demonstrated even with the most sensitive methods of staining; and in the posterior dorsal portion the lesions were very slight, gradually increasing in the lumbar enlargement and becoming most marked in the sacral region. Degeneration in the sensory ganglion cells was present in all stages, varying from the beginning stage of chromatolysis that could barely be detected by the Nissel method alone to advanced degeneration and disintegration or plasmolysis that was brought out by less sensitive methods. The motor ganglion cells and the cells in the column of Clark showed such slight alteration that it was difficult to trace chromatolysis in them. The nerve cells of the spinal ganglia showed chromatolysis in varying degrees. The most marked changes were found in the sensory cells in the sacral region where disintegration of the chromatophil granules was followed by atrophy and sclerosis and was invariably accompanied by peripheral displacement of the nuclei. This was not observed in the nerve cells of the cord.

"The degeneration of the myelin in the medullated fibers was even more pronounced than the degeneration in nerve cells. The black clumps of degenerated myelin stained by the osmic acid of the Marchi method were the characteristic feature of the endoneural and extraneural fibers in the gray substance in the dorsal horns and the dorsal nerve roots as well as of the fibers of the columns of Burdach and Goll in the white substance of the cord. The changes were limited to the lumbar and sacral region. In the sciatic nerve the degeneration was even more marked. We can therefore assume that the disturbances are of peripheral rather than central origin."

Curasson (G.). **Sur l'infection du cheval et du mulet par** *Trypanosoma dimorphon.* [Infection of the Horse and Mule with *T. dimorphon.*]—*Rec. Méd. Vét.*, 1920. Jan. 15–Feb. 15. Vol. 96. Nos. 1–3. pp. 55–59.

In all the colonies of French West Africa trypanosomiasis due to *T. dimorphon* exacts a more or less heavy toll, and although in French

Soudan and Senegal the incidence of the disease appears to be less it would probably turn out that they are also considerably involved if the infected areas in them were known. Whilst stationed at Kayes in 1917 and 1918 the author frequently encountered this disease in horses in the Cotiari and Naye region, either alone or in the same districts as *T. cazalboui* infection. It was also observed among horses employed in the construction of the Thies-Kayes Railway; in the course of two months out, of 72 animals utilised in one place 10 died and 16 were evacuated, and of these 8 more died.

The disease is characterised by its chronicity; but acute febrile crises are quite frequent during the course of the infection. Muscular atrophy involving particularly the muscles of the croup is very marked. Extreme weakness shown especially by stumbling during walking is pronounced; the animal, however, remains standing and does not, as a rule, lie down until a short time before death, when swelling of the hind limbs and of the tendon sheaths and more rarely of the abdominal region also appears. The author states that these swellings can be seen in about half of the animals affected although DUTTON and TODD stated that they had never observed them; LAVERAN, however, produced them in a horse infected experimentally. The swellings disappear when a cardiac tonic such as digitalis is administered or the horse lies down for half a day. They are not observable in the morning in animals which lie down during the night.

The author observed fairly frequently the production of plaques on the scrotum of infected animals. Usually one or two distinctly raised hard plaques appear from one-half to one inch in diameter. On the following day the epidermis covering the plaque becomes raised, thus forming a blister containing a very small quantity of serous fluid. The epidermis is then shed and the plaque becomes transformed into a very finely granulating ulcer which persists for about a week without exuding much fluid and then rapidly heals, until two or three months later hardly a trace of the lesions is apparent. These lesions thus bear some resemblance to the cutaneous eruptions seen in dourine.

In all affected animals the author observed a persistent conjunctivitis with abundant lachrymation together with, as a rule, petechiae on the mucous membrane. In about one half of the cases, a diffuse keratitis accompanied the conjunctivitis, and in recovered animals an irregularly shaped milky opacity of the cornea remained, which in rare cases produced complete blindness.

In the mule the symptoms were appreciably the same but less severe. Ocular lesions were more seldom seen and swelling of the limbs and joints was never observed. In one case only a plaque was seen on the sheath in an imported Algerian mule. The febrile crises in the horse were not of frequent occurrence, but they were so intense that if death did not actually follow the first attack it supervened during the second. The symptoms during an attack were extreme weakness, petechiae on, and congestion and swelling of, the conjunctiva, which formed a bulging rim around the eyelid, copious muco-purulent lachrymation, intensely accelerated respiration, and inappetence; there was no diarrhoea; temperature rose to 41·5° C. These crises were not observed in mules.

Treatment with galyl. The author has already recorded the effects of this drug upon the equine trypanosomiasis known as *souma* [caused by *T. cazalboui* (*vivax*)] [see this *Bulletin*, 1919, Vol. 7, No. 2, p. 57]. The drug was administered to horses and mules affected with *T. dimorphon* in much the same manner. Three grammes were given intravenously on two occasions, viz., 2 grammes the first time and 1 gramme a week later. The galyl was obtained in ampoules containing 0·37 gramme sodium phosphate, 0·25 gramme caffein, and 0·25 gramme sodium benzoate per gramme of galyl. The ampoule was filled with boiled water to dissolve the powder and sucked up through a fine needle before it was used. Care had to be taken not to allow any of the fluid to escape into the tissues outside the vein.

The author gives a list of 15 cases treated. Three were treated with tartar emetic intravenously, and this drug appeared to have no effect upon the disease; 2 received tartar emetic prior to one injection with galyl and they also died. Out of four mules and six horses treated with galyl five died, viz., one mule and four horses, and five recovered (according to the author's table), but two of the horses that died were in a very advanced stage of the disease when treatment was commenced. The recovered horses showed no trypanosomes in their blood when examined for a period of about nine months after treatment. The author considers the results to be less encouraging than those obtained in *souma*; but, on the other hand, the animals infected with *T. dimorphon* were in a very low state, and after administration of the drug a rapid improvement was brought about in the animals that eventually recovered

DELANOË (P.). **Un cas d'infection spontanée du chien par *T. marocanum* Sergent, Lhéritier et Belleval 1915.** [A Case of Spontaneous Infection of the Dog with *T.m.*]—*Bull. Soc. Path. Exot.* 1920. Jan. 14. Vol. 13. No. 1. pp. 23–26.

Spontaneous cases of infection in the dog with the trypanosome causing the most commonly occurring trypanosomiasis in Morocco have not hitherto been observed. In August 1919 the author discovered at Souk-el-Khemis an adult dog affected with emaciation and double keratitis, a lesion which is very noticeable in dogs infected with the trypanosomes experimentally. Examination of the dog proved in fact that the animal had become infected naturally with the trypanosome. The dog was killed and post-mortem a considerable quantity of yellowish liquid exudate was found in the pericardial sac and the spleen was enlarged; there were no other internal lesions. The cornea of both eyes had become completely opaque resembling coagulated albumen but contained no living trypanosomes.

Two guinea-pigs and a rabbit were inoculated with material from the dog. One guinea-pig died two months later after showing an intense blood-invasion, while the other died in three and a half months also after showing extremely numerous trypanosomes in its blood and a scurfy condition of the skin. The rabbit died in three months after showing marked trophic changes (eczema around the ears and nose and loss of hair).

The trypanosome when examined in a fresh preparation shows active wriggling movements but hardly any translatory movements. In the dog it measured from 20·27–28·6μ long by 2·1–4·9μ broad. In the rabbit and guinea-pig it showed much greater variations in size. When stained the cytoplasm assumed a uniform lilac blue tint and the nucleus a bright red with a number of just visible chromatinic granules at its periphery. The flagellum was thick and its free part measured in the dog from 1·4–1·8μ; the blepharoplast stained a deep violet, was rounded or rod-shaped, and was situated right at the posterior end or up to 2·2μ from it in the dog. In the dog the vacuole situated near the blepharoplast was always clearly visible. Forms without free flagellum were rare in the dog but more numerous in the guinea-pig and the rabbit, and very often in such parasites the cytoplasm at the anterior end was drawn out so as to accompany the flagellum to its end; in a fresh preparation, therefore, the organisms appeared to have actually a free flagellum.

VAN DEN BRANDEN (F.). **Action de la combinaison atoxyl, émétique, tryparosan, sur le** *Trypanosoma congolense*. [Action of Atoxyl, Tartar Emetic, and Tryparosan, given in Combination, on *T. congolense*.]—*Bull. Soc. Path. Exot.*, 1919. Oct. Vol. 12. No. 8. pp. 514–517.

In January 1919 an outbreak of trypanosomiasis due to *T. congolense* (*pecorum*) occurred among the cattle of the Breeding Station at Leopoldsville, Lower Belgian Congo, following upon the introduction of a herd of goats from the Upper Congo. The transmitting agent was undoubtedly *Stomoxys calcitrans*. Three out of six cattle were found to be infected and one had become so greatly emaciated that it had to be destroyed. The author and his collaborators had found in 1911, in the course of investigations in Katanga, that tryparosan was the most useful remedy for goats infected with trypanosomes of the *dimorphon-congolense* type. It caused the complete disappearance of the trypanosomes when it was given to these animals on two successive days in doses of half a gramme per kilogramme body weight. In 1915 RODHAIN and the author obtained the same favourable results when the drug was administered in the same dose to sheep, goats, and native pigs infected with *T. congolense* in the Middle Congo.

In the small outbreak here described the atoxyl and tryparosan were given by the mouth while the tartar emetic was injected intramuscularly in doses of one gramme, given in 2 per cent. dilution. Two oxen were given in the first place 0·26 grammes per kilogramme body weight of tryparosan, together with atoxyl in doses of 16 and 17 grammes respectively by the mouth, and a dose of tartar emetic intramuscularly. The injections of tartar emetic appear to have been repeated on five successive days. The animals then improved in condition but in about two months trypanosomes again appeared in their blood and they were again administered tartar emetic and tryparosan. One animal had a further relapse in a month's time and was given tryparosan. Subsequently the animals recovered and no trypanosomes could be detected in their blood for three months, even when tested by guinea-pig inoculation.

[Results which would seem to be as good as these were claimed to have been obtained by HORNBY in the treatment of *T. congolense* infections in the ox after the use of tartar emetic alone (this *Bulletin*, 1919, Vol. 7, No. 2, p. 53). Compare also favourable report on use of this drug alone in treatment of *T. cazalboui* (*vivax*) infections in the Belgian Congo. VAN SACEGHEM and NICOLAS (this *Bulletin*, 1917, Vol. 5, No. 1, p. 21)—ED.].

i. JACOBS (Walter A.). & HEIDELBERGER (Michael). **Chemotherapy of Trypanosome and Spirochete Infections. Chemical Series. 1. N-Phenylglycineamide-*p*-Arsonic Acid.**—*Jl. Exper. Med.*, 1919. Nov. 1. Vol. 30. No. 5. pp. 411–415.

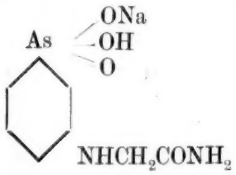
ii. BROWN (Wade H.) & PEARCE (Louise). ii. **Biological Series. I. The Toxic Action of N-Phenylglycineamide-*p*-Arsonic Acid.**—*Ibid.* pp. 417–436.

iii. PEARCE (Louise) & BROWN (Wade H.). **Biological Series. II. The Therapeutic Action of N-Phenylglycineamide-*p*-Arsonic Acid in Experimental Trypanosomiasis of Mice, Rats, and Guinea Pigs.**—*Ibid.* pp. 437–453.

iv. —— & ——. **Biological Series. III. The Therapeutic Action of N-Phenylglycineamide-*p*-Arsonic Acid in Experimental Trypanosomiasis of Rabbits.**—*Ibid.* pp. 455–481. With 21 plates comprising 44 figs.

v. BROWN (Wade H.) & PEARCE (Louise). **Biological Series IV. The Action of N-Phenylglycineamide-*p*-Arsonic Acid upon Spirochete Infections.**—*Ibid.* pp. 483–496. With 7 plates comprising 29 figs.

i. The above authors state that they have been engaged for a number of years in the synthesis of certain new types of organic arsenic compounds for the treatment of experimental trypanosome and spirochaete infections. Although a considerable part of their studies were devoted to the trivalent arsenical compounds their attention was at first confined to the pentavalent group represented by the arsonic acids, these acids possessing certain superiorities over the trivalent compounds especially inasmuch as they formed soluble and stable salts and were more readily prepared. One of these salts in particular, viz., the sodium salt of N-phenylglycineamide-*p*-arsonic acid represented by the following formula



gave particularly interesting experimental results, and the simplicity of this compound, the ease of preparing it, its relatively inexpensive character, stability and solubility, and its favourable biological action are held to warrant a detailed publication of the results obtained. The acid readily yields a colourless crystalline sodium salt which is

extremely easily soluble in water, forming neutral solutions which are quite stable. A 10 per cent. solution may be boiled for some time without appreciable cleavage of ammonia or arsenic.

ii. The toxic action of the drug was studied upon the smaller laboratory animals—mice, rats, guinea-pigs, rabbits, and monkeys. The numerous experiments performed showed that the substance was one which lent itself well to almost any method of administration and could be given to animals in very large doses. The tolerance of the different animal species varied rather widely, but with one exception, the reaction of the laboratory animals to toxic doses of the drug was such that doses closely approaching in magnitude the lethal dose could be safely administered; in other words, the toxic effects were confined to doses relatively close to the minimum toxic dose and the recovery of animals from sub-lethal intoxications was remarkably rapid and complete. This characteristic of the drug made it possible to administer it in very large doses at comparatively short intervals of time without incurring the risks due to cumulative action or to superposition of toxic effects. On the other hand, by taking advantage of this property it was possible to develop such a degree of tolerance in the animals that the dose of the drug could be progressively increased to a point well above that which was found to be fatal to the normal animal.

iii. In their work upon the action of the drug upon trypanosome infections the authors used strains of *T. brucei*, *gambiense*, *equinum*, *equiperdum*, and *evansi*. As is well known, trypanosomiasis as it occurs in mice and rats is chiefly characterised by the constant and progressively increasing number of trypanosomes in the peripheral blood stream, usually by the lack of any clinical manifestations, and by the relatively early death of the infected animal. In rabbits, on the other hand, the disease is pre-eminently a tissue invasion and is characterised in the acute stages by conspicuous oedematous and inflammatory swellings of the soft parts, particularly of the head and external genital organs, together with loss of appetite, weakness and emaciation; in the more chronic phases of the infection the inflammatory lesions undergo induration and even necrosis, involving the deeper tissues including the periosteum and bone; the disease may take many weeks or months to run its course and the presence or absence of trypanosomes in the blood stream is of minor importance.

In order to appreciate fully the therapeutic action of a drug in experimental trypanosomiasis one has therefore to study its effects upon the above two general types of infection, viz., the acute septicaemic form of mice and rats and the chronic tissue invading form of rabbits.

First, the authors studied the action of the drug upon infected mice, rats, and guinea-pigs, the majority of which were inoculated with *T. brucei*. The mice died in from 60–70 hours, the rats in 4–5 days, and the guinea-pigs in, on an average, 4 weeks, after intraperitoneal inoculation. With other trypanosomes of lower virulence the size of the dose was increased so as to produce an infection comparable with that produced by the strains of *T. brucei* utilised. The mice and rats were treated 18–24 hours, and the guinea-pigs usually one week, after inoculation, parasites having been demonstrated in the meantime in the peripheral blood.

It was found that the compound had a marked curative effect upon the infection in these three species of animals. When administered in doses of from 0·2 to 0·3 gramme per kilo body weight to mice and rats that had been inoculated with the several species of pathogenic trypanosomes, complete disappearance of the organisms from the blood was obtained. Since the lethal dose for mice had been found to be from 2 to 2·5 gramme, and for rats 0·75 gramme, per kilo body weight the curative ratios were 1 : 8 and 1 : 3 respectively.

The curative dose for guinea-pigs was 0·15 gramme per kilo body weight, and the curative ratio for these animals worked out at 1 : 10.

The trypanocidal activity of the compound was relatively rapid in all three animal species, the peripheral blood being cleared of trypanosomes within 24 hours after its administration : the lower limits of the curative range were also comparatively sharply defined. The drug was found to be equally efficacious whether administered intraperitoneally, intravenously, or subcutaneously in *T. brucei* infections of mice ; no ill effects were produced following upon the administration of therapeutic doses while the condition of the treated animals showed an immediate and continued marked improvement.

iv. The therapeutic tests were performed on rabbits which showed very well-marked clinical signs of a definitely established disease and in many of the animals the infection was extremely advanced and of prolonged duration. The five species of trypanosomes mentioned above led uniformly to fatal results in untreated rabbits in about from 1 to 3 months after inoculation. With the usual acute, actively progressing infection of from one to two weeks duration produced by the authors' strain of *T. brucei*, the drug had a curative range of from 0·2 to 0·3 gramme per kilo body weight when administered intravenously in single doses, which was from $\frac{1}{3}$ to $\frac{1}{2}$ the minimum lethal dose. Of 29 rabbits treated with doses falling within this range 25 were permanently cured and there were no relapses observed in those given doses above 0·3 gramme.

The infection produced by the authors' strain of *T. gambiense* was controlled by a slightly lower dose, since there were no relapses when rabbits were given single doses of 0·3 gramme each, and one out of three rabbits given single doses of 0·15 gramme each was effectively cured.

The experiments with *T. equinum*, *equiperdum*, and *evansi* are admitted to be too few to allow of final conclusions, but it would appear that the curative range for *T. evansi* infections is very much the same as for *T. brucei* and *gambiense* infections, but larger doses or a different system of treatment would appear to have been indicated in the treatment of the rabbits infected with *T. equinum* and *equiperdum*.

A marked therapeutic effect was also produced by single doses smaller than the single ones which produced an ultimate cure. The administration of these smaller doses was followed by a rapid regression and healing of the clinical lesions of the acute infections produced by all five species of trypanosomes, together with a marked improvement in the general physical state of the animal. On the other hand, single doses considerably larger than those necessary to effect a cure caused no disturbance of a toxic nature.

The authors then suggest a system involving the employment of repeated doses, which might be utilised with advantage in the treatment of both initial infections and relapses in rabbits, especially in cases where there is induration or even necrosis of tissues together with weakness and emaciation. Since the drug apparently possesses the power of tissue penetration to a marked degree it is desirable to give the second dose within a short time after the first in order that it may have a full opportunity for the immediate and complete development of its action.

The repetition of small doses such as 0·15 gramme per kilo body weight on successive or alternate days gave successful results as regards both the immediate regression and healing of lesions and ultimate permanent cures in severe chronic infections. It was found possible, however, to administer increasingly large doses, when necessary, on account of the remarkable tolerance exhibited by rabbits to repeated large doses.

Small doses administered intramuscularly produced effects which were comparable with the results observed after similar doses had been given intravenously; these effects were brought about more slowly after subcutaneous injections. Permanent cures were obtained in *T. brucei* infections after intramuscular or subcutaneous administration of single doses of from 0·2 to 0·5 gramme per kilo body weight and, in other cases, after three repeated doses each of 0·1 gramme per kilo body weight given intramuscularly. One severely infected rabbit which received 0·75 gramme per kilo body weight *per os* immediately following a small dose of sodium bicarbonate was also cured. The authors illustrate in a large number of plates the course of the disease in their rabbits after administration of the drug.

v. The authors next describe the action of the drug upon experimental animals infected with spirochaetes, both blood spirochaetes (*Sp. obermeieri*, *Sp. novyi*) and the spirochaete of human syphilis (*Treponema pallidum*). Rats and mice were inoculated intraperitoneally with blood suspensions of the blood spirochaetes in such doses as to produce an infection of the desired character—usually an infection which would show a few spirochaetes in the peripheral blood within 24 hours after inoculation. The animals were then treated by intraperitoneal injection of single doses of the drug and the results followed from day to day by examination of tail blood by dark ground illumination. The effects of the drug upon *Treponema pallidum* were studied by using the scrotal chancre produced in rabbits as a convenient lesion for observation.

Briefly summarised, the drug is stated to be capable of exercising a very definite effect upon the course of the infections produced by both types. The infection due to the blood spirochaetes was ameliorated and although the spirochaetes were not immediately destroyed the infection was frequently brought to a termination which left the animal in a condition not unlike that produced by the more powerful spirochaete-destroying agents, that is, the infecting organisms were either affected in such a way that they eventually died off or were destroyed by the host in such a way that no lasting immunity was developed in consequence of their destruction

Much the same type of reaction appeared to occur in the treatment of rabbits infected with the spirochaete of human syphilis. If very large doses of the drug are used it may be possible to destroy the organisms completely. In other cases, it was certain that where complete healing of the lesions was accomplished as a result of the treatment the organisms were not destroyed. It appears that healing can be brought about in the presence of numerous actively motile spirochaetes.

With either group of spirochaetes therefore the arsenical compound under investigation appears to act in a manner somewhat different from that of the agents usually employed in the treatment of spirochaete infections. While it does possess this destructive action to a considerable degree its chief effect is seen in the peculiar manner in which it modifies or controls the course of these infections.

[This drug is covered by U.S.A. Patents, and patents have been applied for in other countries, but the taking out of patents has been done merely to ensure the purity of the product and protection against exploitation; all discoveries, it is stated, made at the Rockefeller Institute for Medical Research are made freely available to the public, and, "it is the purpose of the Institute to permit any drugs which may prove of practical therapeutic value to be manufactured under license by suitable chemical firms and other conditions of production which will insure the biological qualities of the drugs and their marketing at reasonable prices. Other than through the issuance of license the Rockefeller Institute does not participate in any way in the commercial preparation or sale of the manufactured chemicals; and it receives no royalties or other pecuniary benefits from the Licenses it issues." Perhaps the Institute might extend its philanthropic projects by issuing supplies of the drug to bona fide veterinarians in the Tropics upon request to test its efficacy upon the natural infections in the field.—Ed.].

Croveri (Paolo). **Osservazioni sulla biologia della "*Glossina pallidipes*" della Somalia Italiana e sulla trasmissione agli animali domestici della Tripanosi detta "Ghendi."** [Observations on the Biology of *Glossina pallidipes* in Italian Somaliland, and of the Transmission of the Trypanosomiasis known as Ghendi among the Domesticated Animals.]—*Ann. d. Igiene.* 1919. July 31. Vol. 29. No. 7. pp. 432–447.

Martoglio (1911) describes three forms of trypanosomiasis in Italian Somaliland, viz., (1) *Ghendi*, caused by *Trypanosoma somalilense* (a new species which he differentiates from *T. dimorphon* on account of the fact that it is not pathogenic for the rabbit) transmitted naturally to the domesticated animals by the bite of *G. pallidipes*, a fly which is known to the natives by the same name as the disease (*Ghendi* in Somali="hurling a javelin," from the manner in which the fly hurls itself upon animals). The disease, naturally, affects all the domesticated animals in the Colony. (2) *Gobiat* or *Gumul*, caused by *T. celli* (n. sp.), transmitted by a biting fly which has not yet been identified but which is probably a stomoxyd. The disease in natural circumstances chiefly affects bovines. (3) *Salaf* or *Ducan*, caused by a

trypanosome which MARTOGLIO considers to be identical with that of surra (*T. evansi*) and which is transmitted to camels, the only animals naturally affected with the disease, by a tabanid as yet not identified.

The observations recorded by Croveri were made in the Territory situated along the middle and lower course of the River Webi-Shebeli, i.e., towards the coast line in the southern part of the Colony. In this region *ghendi* was the cause of very considerable losses among the domesticated animals, and the only species of Glossina discoverable was *G. pallidipes*. The author was able to obtain confirmation of the belief that this species of fly was actually the transmitter of *ghendi*. Moreover, experiments carried out in the laboratory showed that the fly did not become infective for some time after having fed upon an affected animal. It was necessary for a period of from 17–19 days to elapse during which presumably the trypanosome accomplished a certain part of its developmental cycle in the body of the fly.

In nature *G. pallidipes* exhibits a preference for wooded localities covered with a short rank undergrowth in close proximity to stagnant or slowly flowing water. These localities are somewhat limited in extent during the dry season but they become markedly increased in area during the rains and hence the zone infested by the fly becomes considerably enlarged during this season. Open spaces such as meadow land on which cereals, cotton, or sesame are cultivated are entirely avoided by the fly although such land may be planted with tall trees but contains no shrubby growth. On the other hand, banana (or cocoa) plantations or any other land covered with short trees may become infested. Normally on sunny days *G. pallidipes* bites from dawn up to about 8 o'clock. It re-appears towards 4 p.m. and retires again at sunset. On misty or rainy days it may bite throughout the day. On moonlight nights it may bite when it is disturbed from its resting place on the ground or by loud noises. On dark nights it does not bite. The natives appear to place great faith in a decoction of myrrh as a repellant. The author's experiments, on the other hand, seem to demonstrate that this agent rather attracted the flies. The average lifetime of the fly was found to be about three months and the period of pupation about 28 days at a temperature of about 28° C.

DUKE (H. Lyndhurst). **An Enquiry into the Relations of *Glossina morsitans* and Ungulate Game, with Special Reference to Rinderpest.**—*Bull. Entom. Res.*, 1919. Nov. Vol. 10. Pt. 1. pp. 7–20 With 2 charts.

In this paper Duke records a number of observations made in the Masindi fly belt in the Uganda Protectorate during April and May, 1918. Together with FISKE (W. F.) he had already worked in the Northern Province fly belt from May till September 1914, and he was thus in a position to estimate any alteration in the fly distribution which might have occurred as the result of an outbreak of rinderpest in this Province. This disease had first manifested itself in the buffalo of the Chopi Country and it then spread rapidly in 1917 through the game in the *Glossina morsitans* area between Masindi Station and the Kafu River. [See summary of Report of the Chief Veterinary Officer,

Uganda Protectorate, this *Bulletin* 1919, Vol. 7, No. 2, p. 107.] Unfortunately the author's observations were made somewhat late when the outbreak had almost died out and the rains had commenced throughout the District. Examination of the fly area, however, proved beyond doubt to the author's mind that the fly had suffered a very marked reduction as compared with its frequency in 1914; only on one occasion were they at all numerous, viz., at a water hole which had a very short time previously been visited by a large herd of elephant. Other visitors to this area were also struck with the apparent absence of tsetse flies. Rinderpest had killed off a considerable number of buffalo in the area and bush-buck, warthog and duiker also suffered severely while waterbuck and hartebeest were but little affected. The kob and reedbuck of the Kafu Plains died in considerable numbers. A certain number of buffalo had survived the outbreak.

The Bugungu fly country, through which the disease had spread from Chopi, was next visited. The rinderpest epizootic had caused the buffalo to move southwards along the Bugungu Plain to the point where the escarpment joins Lake Albert near the outfall of the Waki River, leaving a train of dead along their course. A striking feature about these carcases was that most of the skins remained intact and the bones were not usually pulled about by carnivora. Carcases of kob and warthog were also found. *Glossina morsitans* was found in various parts of this fly area, but the reduction in numbers was much less marked than in the Masindi Port belt. Numbers of waterbuck had survived and elephants were common. Buffalo had survived in small numbers and kob and reedbuck were also found. Bush-buck and pig were common in 1914, but none were seen alive during the 1918 visit.

It seemed as if the fly had migrated southwards across the Kafu River into the Buruli District, with the buffalo, for this District was only very slightly infested in 1914, but *G. morsitans* appeared to have become quite numerous in some localities in 1918. On the date when this paper was written rinderpest had spread south to within 40 miles of Kampala, and the main agent in this spread is said to be undoubtedly the game, especially buffalo.

The author sums up the situation by stating that there has been a marked diminution in the numbers of *G. morsitans* (the transmitter of nagana) in the Masindi fly belt coinciding with the passage of rinderpest through the game of the District. The fly is not exterminated but the reduction in numbers is much more marked than that which ordinarily results from the annual hot season. In Bugungu the reduction in numbers of the fly is less striking. On the other hand, there appears to be no reduction in the numbers of *G. palpalis* (the transmitter of human sleeping sickness) in either district. In both areas considerable numbers of waterbuck have survived the outbreak; numbers of buffalo have also survived though, on the Bugungu Plains especially, the number of dried carcases testifies to a heavy death roll.

The author examines at some length, in the light of his own observations, the commonly held belief that the spread of rinderpest among the game throughout a fly country brings about a marked diminution in the numbers of the fly. The opinion is strongly held among Europeans of experience in South Africa that the great rinderpest outbreak that occurred there in the nineties produced such a marked decrease that

in some districts the fly immediately or eventually disappeared. This disappearance may be explained in three ways, viz., (1) the fly dies as a direct consequence of absorbing blood from an animal suffering from rinderpest, (2) the fly disappears owing to the loss of its normal food supply, the wild game, (3) the phenomenon has no direct connection with rinderpest but is due to some co-incident cause.

The first of these hypotheses has hitherto received no experimental support. Duke himself describes a number of experiments in which numbers of *G. palpalis* were fed upon calves experimentally infected with rinderpest. It would appear from the results that rinderpest has no harmful effect upon the fly.

On the other hand, the author appears to favour the combination of circumstances such as would be included under the second and third headings, as the probable cause of the disappearance of tsetse. In the Uganda fly areas investigated, the food supply of the fly, viz., the game, was severely reduced by the rinderpest just at the time of the year when food is usually under ordinary conditions most difficult to find. The drought, which had begun in the preceding November, led to an early drying of the grass and commencement of the fires; similarly the intensity and prolongation of the drought during this particular year led to an unusually complete burning of the bush. The fly was thus doubly handicapped; their food supply was diminished at the most critical season of the year, and the adverse conditions of deprivation of shelter and destruction of breeding grounds were intensified by the prolonged drought. These circumstances, at any rate, would account for the remarkable diminution in numbers of the tsetse fly in the Masindi fly belt; the Bugungu country being uninhabited is less subject to burning in the dry season, as these fires are started and kept up by natives.

In the South African epizootic, rinderpest arrived in the North-Eastern Transvaal about June in 1896, and the game was still dying fast in October, the hot season. The grass in this district reaches its full growth in June and in some areas the fires may not commence until September. The author could find no data regarding the particular conditions of the district in 1896–1897, but, as with the outbreak in the Masindi fly area the disease arrived at the season of the year when the grass was up and game most difficult to find.

Hamilton, writing of this outbreak from observations made five years after its occurrence, viz., in 1902, regards the complete and permanent disappearance of the tsetse fly from a large strip of country as coincident with the passage of the rinderpest. Duke thinks it improbable that the fly disappeared completely in the season, and suggests the following explanation. In consequence of the combination of adverse conditions afforded by the arrival of the disease in the cold weather, together with a prolonged dry season with consequent more complete burning of the grass, the fly was very markedly reduced between June 1896 and April 1897. Small isolated foci probably persisted which, for reasons undetermined at present, instead of increasing, diminished to the point of absolute disappearance before Hamilton's arrival in 1902.

To exert its maximum effect upon the fly the epizootic should arrive in a belt during a season when the grass is long. If the disease passes

through country where the grass is yet short and the game easy to see the effect on the fly may be less severe ; tsetse is then better able to follow the migratory movements of the susceptible game, and to locate the whereabouts of such relatively immune species as waterbuck, impala, and hartebeest, which are distributed in localised areas.

It follows from these observations that *G. morsitans* can be combated in practice by :—(1) Destruction of the primary centres or foci referred to by SHIRCORE and FISKE by filling in or drainage of the water supply ; destruction of game in the vicinity, and careful burning of the grass during the dry season of the year. (2) Careful control of bush burning so as to obtain the maximum effect of the fire ; indiscriminate and patchy burning by natives to be stopped and the fires started and maintained in a systematic manner so as to ensure universal burning of the grass.

SANDER writing of tsetse fly in German East Africa in 1905 states that both Europeans and natives attribute the increase and spread of tsetse in the area between Tanga and Kilimanjaro to the cessation of annual grass fires. The game in this area had diminished very greatly.

JACK (Rupert W.). **Tsetse Fly in Southern Rhodesia, 1918.**—*Bull. Entom. Res.*, 1919. Nov. Vol. 10. Pt. 1. pp. 71–90. With 3 plates & 3 maps.

In this paper the author gives a detailed account of the present situation and past history with regard to tsetse fly in Southern Rhodesia up to the year 1918. An extract of a popular account on this subject has already appeared in this *Bulletin* [1919, Vol. 7, No. 1, p. 18]. Up to the year 1918 the history of the fly on the whole appears to be one of expansion although, on the other hand, one small but important belt appears to have become extinct. In addition a fly area in the Moçambique Company's territory has extended up to the Eastern border of Southern Rhodesia with the result that serious losses of cattle from trypanosomiasis have occurred on the farms in that region. Although detailed reports on the advance or retrogression of *Glossina morsitans* in other parts of Africa are not obtainable the review of the situation as it at present stands in Southern Rhodesia is not without general interest.

There are at present six known fly belts in the territory.

(1) Sebungwe Belt, occupying the greater portion of the western half of the Sebungwe District. Owing to its extent and the fact that human sleeping sickness is endemic in a certain portion of it this is at present the most important fly area in the territory. The author has already published an account of the extension of the infested country since it shrank to insignificant proportions in 1896–7 until the year 1913 [see this *Bulletin* 1914, Vol. 2, No. 4, p. 174]. During the years 1913–1918 this extension has been continued until the present area of the belt is estimated at 4,500 square miles. It is stated that, speaking broadly, the contentions of the early hunters concerning the association of *Glossina morsitans* with big game are fully supported in this area, although this is not invariably the case elsewhere. The increase of the fly and the expansion of its boundaries have corresponded with a notable increase of the larger antelopes and, to a smaller extent,

of buffalo. The new territory occupied by the fly is all game country, and the most rapid extension has taken place through country where game abounds. The fly is most abundant at points where game congregates during the latter part of the dry season, and the advance appears to have come to a standstill at more than one point where the country beyond is sparsely inhabited by game. Evidence is adduced to demonstrate the striking relationship of game and fly in this belt.

(2) Umniati Belt, lying astride the Umniati River partly in the Hartley and partly in the Sebungwe Districts. In 1896–7 this belt appears to have shrunk to very small dimensions but the exact position at that time is somewhat obscure. Subsequently the belt extended, in common with other fly areas in the territory, and in the presence of considerable quantities of big game Its present area is judged to be about 1,000 square miles. When this part of the country was visited by the author in November 1910 the southern limit of the fly on the Umniati River was about 7 miles further north than it was in 1918. In 1910 game was plentiful on both sides of the river but especially on the west and included elephant, rhinoceros, eland, kudu, sable, waterbuck, impala, and warthog, whilst bush-buck was at that time and still remained in 1918 moderately abundant along the river itself. In addition to game large and numerous troops of baboons frequented the river and up to 1918 they had shown no decrease in number.

The adjacent portion of the Hartley District has been opened to free shooting, with one break, since 1905, and this has had an adverse effect on the game on the Sebungwe side of the Umniati River. Professional hunters camping in the above area have poached regularly beyond the Umniati and of late years game has become very scarce where it was abundant as late as 1910 and fairly abundant up to 1912. Between 1910 and 1912 the fly extended about 7 miles up the Umniati but since 1912 it seems to have come to a standstill at this point. In the western part of this belt it is probable that the persistent presence of large numbers of baboons may have been a factor in the spread of the fly, although some authorities strongly dispute the fact that these animals ever allow themselves to be fed upon by tsetse.

The point, however, of peculiar interest in connection with the belt is that the fly has shown no tendency to spread in a south-eastern direction towards the railway line although the country appears to be topographically suitable. And, it has to be noted that the game has been kept down very effectively by hunters in this area for a number of years past.

(3) Northern Belt, occupying the greater part of the country between the escarpment and the Zambesi River in the northern portion of the Lomagundi District and extending eastward into the Darwin District. This region has not been visited by the author since 1912. It is untouched by civilisation and since the year of the rinderpest epizootic the fly has, according to numerous reliable reports, increased and spread very greatly. The infested country was estimated to include about 2,500 to 3,000 square miles in 1918.

(4) Jetjenini Belt in the neighbourhood of the Jetjenini Mountain in the Lomagundi District. The infested country in this region remains untouched by civilisation as far as the forest is concerned.

but owing to its accessibility it is a favourite shooting area among hunters, and game is less plentiful than it has been in the past. Tsetse occurs, but not in great numbers, and of late years has shown little or no tendency to spread. The stationary nature of the belt is all the more significant in view of the fact that in pre-rinderpest days the fly used to extend considerably further south. The belt in 1918 was about 450 square miles in extent. In 1914 an outbreak of trypanosomiasis occurred among some cattle which had been running for eight or nine months on the Chumsenga River, a little south of the supposed limits of the Belt but further evidence showed that the southern limit had remained stationary.

(5) Suri-suri Belt, in the vicinity of the Suri-suri River between Hartley and Gatooma, in the Hartley District. From all appearances tsetse has now died out in this area. Tsetse in the Hartley District shared in the general shrinkage of 1896–7 and has not reappeared in many parts which were formerly infested, notably in that portion lying east of the railway. From 1898 onwards, however, tsetse began to make its presence felt again in the Hartley District, and by 1902 it was present in considerable numbers in the neighbourhood of the Suri-suri and Shagari Rivers. There is ample evidence, it is stated, to the effect that during the subsequent years the fly was abundant in certain parts of this area and continued to be so until the year 1908. The year 1908 seems to have been marked by an unusually large number of cases of trypanosomiasis around the Suri-suri fly area and the losses continued during the early part of 1909. The numbers of fly had just then reached their culminating point and from the years 1908–1913 the records show that a great reduction of fly took place in the area. Coincidentally there is strong evidence to prove that there was a comparable striking reduction in the number of big game, due to the throwing open of this area for free shooting. During these years the district became the scene of considerable agricultural and industrial, especially mining, activity, and large tracts of forest were cleared. There is strong evidence to show that the fly had become eradicated in a large area of forest, in which the game had become reduced by persistent hunting, before it had been cleared away by the spread of civilisation. The author brings forward certain information which, he believes, establishes firmly that, (1) there was a notable reduction of fly in the basin of the Suri-suri, Umswezwe, and Shangari Rivers between the years 1908 and 1913 ; (2) there was a coincident reduction of large game ; (3) a considerable area surrounding the upper portions of the three rivers mentioned still remained virgin forest as late as 1913.

In 1914 transport oxen engaged in the work of clearing the forest contracted trypanosomiasis in the proportion of nearly 25 per cent., but inasmuch as heavy losses from trypanosomiasis have occurred of recent years amongst cattle living outside the known fly areas these figures by no means suggest any great abundance of tsetse at the period involved. A few fly were found in 1914 to the south-west of the cleared area, associated with the Nswumzwe River but in June of that year the author encountered only a single specimen when looking for fly in the locality. The scattered remnants of the fly apparently died out in a comparatively short time and no cases of trypanosomiasis associated with the Suri-suri area have been recorded since 1916.

(6) Melsetter Border Belt, lying almost entirely in Portuguese East Africa but affecting certain farms on the eastern border of the Melsetter District. Since 1914 cattle on these farms have become infected with trypanosomiasis during the summer months. The species of fly implicated is not *Glossina morsitans* but *G. brevipalpis* Newst. and *G. pallidipes* Austen. These two species are intermingled in the strip of country lying across the border from the affected farms. The situation in the Melsetter District is probably unique, and constitutes an instance where a very considerable degree of settlement and development lies immediately adjacent to practically primitive conditions across a boundary which is both political and natural. Experience indicates that the cattle on the Rhodesian side are only subject to infection during the wet season and the flies therefore probably extend their range at this season as also do *G. morsitans*. Practically all cases are traceable to stock having been in contact with the forest during the wet season. They appear to graze on its outskirts with impunity in the winter. No specimens of tsetse have as yet been taken within the Rhodesian border in this region, and the flies in 1917 were present only in small numbers in the neighbourhood of the border on the Moçambique side. There is reason to think that in Melsetter, as elsewhere, some agency other than tsetse may serve to transmit the infection from an infected beast to others herded in its vicinity.

Breeding haunts of *Glossina morsitans*.—The vast bulk of the forest in Southern Rhodesia consists of three species of Brachystegia producing the type of forest known to the Matabele as "Gusu" and the well-known "Mopani." The trees in the Gusu forest generally appear to become leafless all over the Territory at about the same time of the year, viz., late in July. In many places, as at Salisbury, the new leaves appear again almost immediately and if this were the case everywhere no marked seasonal change in the distribution of the fly in Gusu country would presumably take place. In all the fly country known to the author, however, the forest does not as a rule come into leaf again until the middle of November or later, being evidently dependent upon, to some extent, the commencement of the heavy rains. The habit of the Gusu forest varies considerably with the soil and subterranean water supply. Mopani forest, however, is never noticed in foliage between the end of July and the beginning or middle of November. During the leafless period tsetse congregates in those parts of the fly belt where there are evergreen trees, such as Ficus, Acacia, *Parinarium mobola*, *Diospyros mashuna*, *Kigelia pinnata*, etc., which grow on the banks of watercourses, the edges of vleis even though these dry up on the surface during the dry season, and sometimes on ant heaps. The concentration of the fly from August to November and its general distribution during the wet season and the first half of the winter render observations bearing on the question of its most prolific breeding season very difficult. There is a general opinion that the fly is most abundant in October and November and it is certainly most in evidence during these two months, but being much more widely scattered at most other times it is difficult to draw comparisons. Nevertheless information of great value would have been obtained if

it were definitely established that the hot months preceding the rains are of the greatest importance to the welfare of the fly.

The author next dwells upon the transmission of *Trypanosoma pecorum* in the absence of tsetse, the relation between *G. morsitans* and big game, the expansion of fly belts, and the manner in which fly belts extend. There appears to be conclusive evidence that trypanosomiasis in cattle due to *T. pecorum* has actually been spread in Rhodesia, particularly in the Hartley District, in the absence of Glossina.

The case for the vital association of *G. morsitans* with the larger mammals appears to the author to be extremely strong, in South Africa at least, and the evidence brought forward in opposition comparatively insignificant. There appears to be no direct evidence at all that *morsitans* feeds to any great extent on the smaller mammals under natural conditions, and the failure to find trypanosomes in the blood of such mammals by MONTGOMERY and KINGHORN and the Royal Commission in Nyasaland constitutes direct evidence to the contrary. Whatever may be the truth concerning the vital dependence of *morsitans* upon the mammals in all areas, the author states, there is every reason to believe that the fly feeds upon them by preference and thrives best in their presence, and apart from any other consideration this constitutes a powerful argument for the suppression of the larger game animals, which are, in any case, bad neighbours to farmers and stockowners. The author was able to obtain records with regard to the rainfall in South Africa during the year of the rinderpest epizootic of the 90's and of the few years preceding it. It would appear from these records that there was nothing abnormal in the climatic conditions during the period which saw the disappearance of the tsetse fly. The author attributes the fact that tsetse remains confined within certain limits (although the surrounding country may be just as or even more, favourable to the pest) to the possession of a definite instinct to avoid wandering. The fly, moreover, shows a remarkable lack of adaptability and appears guided mainly by parental experience. It thus develops a strong instinct against wandering which functions whether the surrounding country be favourable or not.

According to the author's observations in Southern Rhodesia the advance of the fly does not take the form of disconnected offshoots at a distance from the main belt but the whole movement is analogous to a rising flood flowing along favourable channels and gradually extending the flooded area. When the line of advance is interrupted in regard to permanent shade as in crossing a watershed the movement is confined to the wet season. Large numbers of flies are necessary at the previous dry season limit before a moderately wide region affording only summer shade can be crossed. The fly again only spreads in the presence of considerable quantities of the larger mammals.

It is then suggested that the clearing of a comparatively narrow strip of forest might serve to check the advance of the fly notwithstanding the fact that the males would constantly be carried across to the other side. The cost and maintenance of such a clearing would be prohibitive on a great scale but by taking advantage of local conditions it might prove practicable to check the advance of a belt in some particular direction. An experiment of this nature was actually

commenced on the south-western extremity of the Sebungwe belt in October 1918, but had to be abandoned temporarily owing to the influenza epidemic.

SERGENT (Et.). i. **Influence du froid sur le développement du *Plasmodium relictum* chez le moustique.**—*Bull. Soc. Path. Exot.*, 1919. April. Vol. 12. No. 4. pp. 174–176.

——. ii. **Le *Plasmodium relictum*, agent pathogène du paludisme des oiseaux, ne donne pas une maladie mortelle au moustique transmetteur.**—*Ibid.* Nov. No. 9. pp. 601–603.

——. iii. **Dans le paludisme des oiseaux (dû au *Proteosoma*), il n'y a pas de parallélisme entre l'infection sanguine de l'oiseau et l'infection consécutive du moustique contaminé par l'oiseau.**—*Ibid.* pp. 603–605. With 1 text-fig.

i. The optimum temperature for the development of Plasmodium in the gnat is somewhere between +20° and +30° C. Experiments were made in order to ascertain what degree of cold produced a sterilising effect, especially during the first few hours after an infective bite, upon the ookinete, which is obviously more fragile than the zygote, the encysted resistant form. From these observations it was found that a temperature of +12° C. maintained for a period of six hours after the infective bite did not prevent the infection of the insect with the parasite. From the sixth hour onwards the organism, however, was liable to be sterilised by this temperature of +12° C. The extreme limit of resistance was about three days. The effect of cold is always directly proportional to the length of time it is maintained. This sterilising effect of cold may be manifested also after the gnat has been kept for the first 15 hours after the bite at the optimum temperature (+20° to +30° C), and even upon the sporozoite after it has reached the salivary glands.

ii. Several hundred cases of massive infection of gnats (Culex) with *Plasmodium relictum* were observed. Each gnat harboured at least 100 zygotes that had arrived at their maximum degree of development. These gnats never appeared to become affected with a higher mortality rate than control gnats (that is gnats containing only a few zygotes or clean gnats that had not been nourished upon Plasmodium blood). Several hundred slightly infected gnats and several millions of clean gnats were placed in the same conditions, in similar cages and submitted to the same temperature, moisture, and food conditions. The observations were also made during various seasons and with virus obtained from several sources. The accomplishment of the life cycle of the bird malaria parasite in the gnat does not therefore appear to produce any ill effects upon the insect itself.

iii. The author has already shown that in bird malaria there occurs after an incubation period of from three to ten days a severe blood invasion during the course of which the parasites remain very numerous for about a week. If the bird survives they rapidly (i.e., in 3–6 days) become very rare. A few irregular increases in numbers occur during the next few weeks before definite recovery or a latent infection producing a relative immunity in the absence of visible parasites in the peripheral blood take place. Whilst the acute stage lasts blood parasites in various degrees of development may be

seen and gametes are very numerous—several may be seen within each field of the microscope. Gnats fed upon this severely infected blood become intensely infected ; 103 gnats showed 3,714 zygotes, i.e., each gnat showed on an average 36·05 zygotes. If the insects are fed upon the blood of a bird a few days after the acute stage when the gametes are very rare (i.e., about the 2nd or 3rd week after the appearance of the parasites) the number of zygotes that can be subsequently obtained from each insect is quite out of proportion to the number of gametes observed on microscopic examination of the blood. 98 gnats showed 1,394 zygotes, i.e., each gnat showed 14·2 zygotes.

During the sixth and seventh week after the acute stage the blood parasites in the bird are extremely rare or may not be found at all even after very careful examination. Nevertheless 30 gnats fed on such a blood gave rise to 13 zygotes, i.e., each gnat showed on an average 0·43 zygote.

It is therefore concluded that in bird malaria the blood remains very infective for the insect during the fortnight which follows upon the acute stage in spite of the poverty in numbers of the parasites in the blood during this period.

Brug (S. L.). **Quelques notes sur les protozoaires, parasites intestinaux de l'homme et des animaux. ii.** *Entamoeba cuniculi.*—*Bull. Soc. Path. Exot.* 1919. Nov. Vol. 12. No. 9. pp. 631–632.

In the faeces of an imported Australian rabbit the author found besides a number of oocysts of coccidia a fairly considerable number of cysts bearing a strong resemblance to those of *Entamoeba coli* of man. These cysts were nearly all quite spherical in shape although a few were oval, and they varied in diameter from 8·8 to 18·4μ, usually 12–15μ.

In the fresh state the cysts showed a highly refractile envelope surrounding a clear cytoplasm without inclusions or vacuoles, and in which the nuclei were easily visible. Each cyst contained eight nuclei. In preparations stained with iron haematoxylin many cysts did not stain at all whilst others were well-stained. The cyst envelope was double-contoured. The chromatin in the nuclei was for the most part collected in three or four small masses which were adherent to the wall of the nucleus : a small central karyosome could be seen in some nuclei. The rabbit was given a dose of castor oil in the hope of obtaining the motile stages in the faeces, but without result. The cysts were found for a few days in the faeces after they had been first discovered but in diminishing numbers ; subsequently, they were no longer found.

The cysts showed a most complete resemblance to those of *E. coli*. Meanwhile, the author provisionally suggests the name *Entamoeba cuniculi* for the rabbit parasite.

Bauche (J.) & Motais (F.). **Sur un nouveau cas de dysenterie amibienne du chien.** [A Fresh Case of Amoebic Dysentery in a Dog.]—*Bull. Soc. Path. Exot.* 1920. March. Vol. 13. No. 3. pp. 161–165.

Intestinal amoebiasis in the dog was described for the first time by Kartulis in 1891. This author observed an Irish terrier affected

with dysentery similar to human amoebic dysentery and in the mucous bloody faeces amoebae were found almost in pure culture. After death of the animal the parasites were found in the intestinal ulcers and were identical in appearance with the amoebae of human tropical dysentery. Recently, WARE described eight cases of this disease in Madras among imported dogs [see this *Bulletin*, 1916, Vol. 5, No. 3, p. 172]. [See also DARLING, on amoebic dysentery in the dog in the Panama Canal zone.—*Ibid.* p. 89.]

The author's case occurred in a pointer bitch $4\frac{1}{2}$ years old which had arrived in French Indo-China a fortnight previously. Three days after having been admitted under the author's observation the bitch showed loss of appetite, quite marked general symptoms, and very frequently passed faeces composed almost entirely of blood and mucus shreds. When examined under the microscope, the faeces appeared to contain: —(1) Large numbers of red and white blood corpuscles. (2) Numerous flagellates resembling the human flagellates (Tetramitus or Trichomonas). (3) Numerous very motile amoebae with a distinctly differentiated and refractile ectoplasm throwing out pseudopodia with rapidity and with an excentrally placed nucleus. They were of about the same size as the amoeba of human dysentery (25 to 30μ) and stuffed with bacteria and blood corpuscles. After staining with iron haematoxylin the parasites were found to contain vacuoles of unequal size and to be provided with an excentrally placed nucleus. (4) Eggs of *Spiroptera sanguinolenta*. On the following day the bitch was injected subcutaneously with 5 centigrammes of emetine and on the next day the symptoms were quite appreciably alleviated, the appetite returned, and the number of bloody mucous evacuations diminished. On microscopic examination flagellates were seen but no amoebae. Thenceforward up to the ninth day after the first symptoms the amoebae were absent from the faeces and the general condition appeared to be satisfactory. On the 10th day, however, a few amoebae again made their appearance in the faeces and could be seen up to the 18th day, but the bitch was then given a further injection with 5 centigrammes of emetine. This brought about a marked diminution in the number of the amoebae (only one or two could be seen in each preparation). The animal became weaker and subsequently vomited but showed no appreciable fever. On the 22nd day a further injection of 4 centigrammes of emetine was given, which was followed by frequent vomiting and general weakness. The animal succumbed on the 26th day after having shown fever during the preceding day.

On post-mortem examination tumours caused by Spiroptera were found, one in the stomach and one in the oesophagus, together with dysenteric lesions in the form of discrete ulcers in the large intestine. Sections of these ulcers showed necrosis affecting the mucous membrane and sub-mucous coat but the lesion contained no amoebae. It is mentioned as probable that death was caused by the injection of emetine.

GAUDUCHEAU, commenting upon this paper, states that in 1913 he described a case of very acute dysentery in a young dog. The faeces of this animal contained considerable numbers of amoebae of the same type as the human parasite but they appeared to be of a somewhat smaller diameter than those usually found in man. The animal was one of a lot of four young dogs which had been fed upon the faeces of

several men affected with dysentery and containing abundant amoebae and flagellates. Blood and mucus were passed for four days after feeding and after the disease had been in progress for two days the animal was killed and about four or five grammes of its intestinal mucus were placed in the rectum of another young dog, the rectum being sutured in order to prevent expulsion of the material. After an incubation period of five days this second dog showed dysentery with very rare amoebae and rare flagellates in its faeces. It died after nine days from intestinal intussusception. The blood-stained contents of the intestine were placed in the rectum of still another young dog. Six days later this animal showed marked diarrhoea. but no amoebae or flagellates were seen in its faeces and it then recovered. In French Indo-China it appears that dogs are much addicted to devouring human excreta.

KUSAMA (Shigeru), KASAI (Katsuya) & KOBAYASHI (Rokuzo). **The Leucocytogregarine of the Wild Rat, with Special Reference to its Life-history.**—*Kitasato Arch. Exper. Med.* 1919. Aug. Vol. 3. No. 2. pp. 103–122. With 1 coloured plate comprising 3 figs., & 2 plates comprising 6 figs.

The above organism is a common protozoan parasite in the leucocytes of the rat in many parts of the world, and it appears to produce no ill-effect upon its host. Leucocytogregarines have up to the present been identified in many other species of animals,—dogs, jackals, hyaenas, palm squirrels, cats, hares, mice, Australian bandicoot, California ground squirrels, hamsters, marmots, shrew mice, rabbits, field voles, and field mice. The investigation of the biology, especially the life-cycle of these sporozoan parasites, however, still remained far from complete. CHRISTOPHERS (1906) in India found that the asexual reproduction of *Leucocytozoon canis* takes place in the bone marrow of the dog, and in the following year he demonstrated the sexual cycle of the parasite in the dog tick (*Rhipicephalus sanguineus*). In 1908 MILLER attributed an outbreak of disease among white rats in Washington, U.S.A., to a leucocytogregarine parasite. This worker proved that schizogony takes place in the liver of the rat and sporogony in the body of the rat mite (*Laeleps echidninus*, Berlese). He concluded that infection was transmitted to the rat by swallowing the mite. In 1911 WENYON claimed to have found the large oocyst of *L. canis* in the dog louse. CARINI (1910) in Brazil and FRANÇA and PINTO (1912) in Portugal worked at *L. muris* and observed that schizogony takes place not only in the liver but also in the lung of the rat.

Leucocytogregarines are not rare among wild rats in the city of Tokio and they are found in from 1 to 2 per cent. of all the common three species of wild rat. The parasite was found chiefly in the large mononuclear or transitional leucocytes but very rarely in the polynuclears. It is situated in the cytoplasm of the leucocyte and pushes its nucleus towards one side. Usually only one parasite is found in a single leucocyte but occasionally two may be found. Sometimes the parasite was found free-living in the plasma ; and, the free-living form might belong to one of two stages, viz., a young motile form just liberated in the blood after schizogony had been completed in the liver and an immotile adult form freed by the death of the host

cell. The free living young gametocyte is an elliptical body exhibiting a slow vermicular movement. It measures 6·8 by 5·1μ when contracted or 12·0 by 2·0μ when elongated. The young gametocyte soon loses its motility, becomes larger and more spherical and finally assumes a spherical or short elliptical form. The spherical form when stained has a diameter of 7·6 to 8·5μ and the elliptical one 8·5 to 11·1μ by 7·6 to 8·5μ. The adult gametocyte is slightly narrower than the young one and measures from 7·7 to 10·2μ by 3·4 to 5·1μ when stained. It differs from the young form in that it is surrounded by a thin capsule and the nuclear chromatin forms a mass which may exhibit a great variety of shapes. The adult form is generally intra-cellular but it can occasionally be free-living, and non-motile. The free adult gametocyte is in all probability liberated into the plasma by the death of the host leucocyte. It was not possible to differentiate between male and female forms of gametocyte in the blood.

Schizogony.—In order to follow the development of the parasite in the liver, a number of rats were fed upon mites containing ripe sporozoites, and then individual rats were killed off in 6, 12, and 24 hours after feeding, daily up to the 17th day, and on the 21st, 24th, 25th, and 35th days. Blood and liver smears and liver sections were prepared from each of these rats.

It was found that the sporozoite swallowed by the rats made its way within 24 hours from the alimentary canal into the liver cells. Here it underwent schizogony three times, requiring from 13 to 14 days to complete the process. The parasite was set free, after destruction of the invaded liver cell, as a gametocyte into the peripheral circulation. A small number of merozoites, however, invaded liver cells to perform a fourth schizogony extending through four days from the 14th day to the end of the 17th, and a still smaller number of merozoites completed schizogony lasting four days for the fifth time. The schizont in the liver when first seen was pear-shaped and measured 14·1 by 5·1μ; a ribbon-shaped nucleus was located at one extremity. On the fourth day the schizont had become oval in shape and increased in size to 30 to 33μ by 24 to 28μ. The nuclei had increased from 8 to 30 in number and were disposed at the poles. The merozoites liberated corresponded with the schizonts as first seen in the liver cells.

Sporogony in the body of the mite.—A large number of normal mites removed from normal white rats were collected and stored for two days in a glass jar and then an infected white rat was placed among them. After feeding for one or two days the rat was removed and a normal rat placed in the jar instead, to keep the mites alive. The mites were then picked out at intervals and examined in smear and section preparations. The normal development of the parasite was observed in only 50 out of over 1,000 mites thus examined.

In from 6 to 12 hours after ingestion the leucocytes were digested in the stomach of the mites and the enclosed gametocytes set free. In one or two days after infection the free gametocytes were seen to lose their cystic covering and each become an elongated motile body. At this stage three types of organism could be identified, viz., (1) a slender form (14·0 by 2·6μ), (2) a stout form (10·2 by 5·1μ), and (3) an intermediate sized form (12·0 to 12·8 by 3·4 to 4·2μ). The slender form was distinguished by having a nucleus consisting of a dense collection of chromatin particles. The nucleus of the stout form on the other

hand contained loosely arranged chromatin particles. These two forms appear to indicate sexual differentiation, for when two gametes were observed in conjugation a similar dimorphism was noticeable. The slender vermicule would correspond with the microgamete, and the stout one the macrogamete. In the stomach contents both single and paired elements were found. The microgamete later became crescent shaped and partially encircled the macrogamete, which became thicker and larger; the two cells then fused together.

Three or four days after infection the two elements thus united to form a spheroidal body (11 to 12 by 8 to 10μ) and the cytoplasm of this zygote revealed a meshwork, staining deeply at the periphery; the nucleus containing scattered chromatin particles lay in the centre of the cell. The zygote now became a motile ookinete. No reduction process in the nuclear substance could be detected. At this stage ookinetes measuring 22 by 20μ and 44 by 34μ could be seen, and the cytoplasm of the largest forms stained so deeply as to obscure the nucleus. The ookinetes were never detected in the stomach of the mite but were always found in the body cavity or between the muscle fibres, where they became stationary and formed oocysts.

The subsequent development of the oocyst was very rapid. Five or six days after infection it became a large sphere 70 to 130μ in diameter consisting of an intensely staining meshwork. The nucleus underwent division with the production of 50 to 150 daughter nuclei arranged towards the free surface of the cytoplasm. Seven or eight days after infection each daughter nucleus surrounded itself with a cytoplasmic mass and developed into a sporoblast. The cytoplasm of each sporoblast possessed a network containing many non-stained large round granules, and the nucleus had a marked nucleolus. Nine to ten days after infection the cytoplasm stained more deeply and the nucleus divided into 8 to 26 daughter nuclei each of which surrounded itself with a cytoplasmic mass; the sporoblast thus became converted into a sporocyst containing a number of sporozoites. Eleven days after infection mature sporocysts were found in groups throughout the body cavity of the mite. The fully developed sporozoite measured 15·3 to 24 by 3·4 to 5·1μ and was capable of slow movement. When stained it was vermicular in shape and the nucleus was placed towards one end of the parasite and consisted of chromatin particles arranged in the shape of a quadrilateral figure, ribbon, or rosette.

The authors then quote observations which prove that infection of the rat actually takes place by ingestion of the mite and not by means of bites from infected mites. Blood from infected rats was found to be non-infective when injected into normal susceptible rats. A slight infection was detected, however, in animals injected with an emulsion made from the liver of infected rats. It would also appear that the sporozoite after having reached the stomach of the rat makes its way to the liver along the blood stream and not along the lymphatics or the bile ducts. Attempts at infecting monkeys, dogs, cats, rabbits, guinea-pigs, mice, and field voles by feeding with infected mites gave negative results.

A certain degree of immunity was found to be set up against subsequent invasions of the parasite after one attack. This immunity was

very noticeable in about one month after the time when the parasites could no longer be found in the blood.

A number of white rats were infected experimentally in order to determine the pathogenicity of the parasite. No clinical symptoms whatever were set up. However, a very marked leucocytosis was always produced. From about the 20th day after infection the leucocytes increased to almost 2½ times the number seen in the normal white rat. This marked leucocytosis was due to a great increase in the large mononuclear and transitional leucocytes while the other varieties remained almost normal in number. Thus the two types of leucocytes that had undergone an increase were those most frequently invaded by the parasite. No other change was seen except a slight enlargement of the spleen.

The parasite was occasionally found phagocyted in the stellate cells of the liver, in the reticulo-endothelial cells of the spleen, and very rarely in the bone marrow. The authors suggest the name *Leucocytogregarina innoxia* for the parasite. It is probably similar to *Leucocytozoon ratti* Adie, and possesses many points of resemblance to *Hepatozoon perniciosum* Miller, but differs from the last-named in that it produces no ill-effect upon the health of the host.

DISEASES DUE TO METAZOAN PARASITES.

ALDIGÉ (E.). **Microfilariose du cheval en Afrique occidentale française** [Equine Microfilariasis in French West Africa.]—*Rec. Méd. Vét.* 1920. Jan. 15–Feb. 15. Vol. 96. Nos. 1–3. pp. 46–54.

CAZALBOU has described the presence of filarial embryos in the blood of the horse, antelope, ox, and ass in the French territories of Upper Senegal and Niger. Aldigé states that since 1908 he has frequently observed specific microfilariae in the blood of the horse, ass, dog, and ox. The embryos are found especially at the periphery of preparations examined either fresh or after fixation.

When examined in the fresh state between slide and cover glass the microfilaria of the horse appears to exhibit extremely active wriggling movements, which are sometimes so intense that it cannot be distinctly seen, and marked translatory movement. If the cover glass is rimmed with vaseline feeble movements can be seen 24 hours after the blood has been taken. After death the organisms are very variably disposed.

The parasite is unsheathed, and small but rather irregular in size. After fixation and staining it measures from 120 to 175μ (average about 140–150μ) by 4·5 to 5μ, and these variations may be observed in specimens examined in one smear. As in other microfilariae a nucleated column and a number of clear spots can be recognised within the outer musculo-cutaneous layer. The nucleated column occupies the whole thickness of the parasite and is composed of a number of irregularly shaped and disposed elements more or less adherent to each other and at places enclosing a clear space. At the cephalic

extremity it divides into two columns often of unequal length (1 to 3μ) which almost touch the cuticle. At the caudal extremity the column reaches the extreme end and its constituent elements diminish in size but increase in length gradually as they approach this extremity.

There appear to be three clear spots constantly present, viz., a cephalic spot, a V-shaped spot, and a caudal spot. The cephalic spot is enclosed by the cuticle and the bifurcated anterior portion of the nucleated column. The V-shaped spot, which is situated at the end of the anterior third of the body, forms a sort of refractile triangle with its base adjacent to one side of the body and its summit touching more or less the opposite wall. The caudal spot, which is the largest, measuring from 5 to 6μ in length, is elongated oval in shape, its longest diameter running parallel to the longitudinal axis of the embryo and it occupies the greater part of even the whole of the breadth of the body. There are other small spots of irregular occurrence : the most commonly seen appears to correspond with the oblique spot of the human microfilariae and it is seen at a distance of about 15μ anterior to the V-shaped spot. Another small spot of variable shape is sometimes seen towards the middle of the body. Besides, the nucleated column sometimes presents one or two interruptions in its continuity in its caudal portion. Depending upon the size of the microfilariae, the oblique spot is situated at from 20 to 30μ, the V-shaped spot at 35 to 65μ, and the caudal spot at 90 to 130μ, from the oral extremity.

The organisms exhibit no periodicity. They were found at all hours of the day and night in severely infected animals.

The embryos were frequently observed in the blood of horses born and bred in Guinea and in Senegal or recently imported into these Colonies from Upper Senegal and Niger. Statistics gathered by the author showed that the parasite was distributed throughout Guinea and Senegal and very probably also throughout Upper Senegal and Niger. Probably the parasite would be found in all those parts of French West Africa infested with mosquitoes. The adult form was not discovered. Two mares which had shown the embryos in their blood and had subsequently succumbed to trypanosomiasis did not reveal the adult filaria post-mortem. The number of embryos observed in a drop of blood taken from the ear varied considerably. It was sometimes necessary to examine two or three preparations before one specimen could be discovered. As a rule they were somewhat rare, amounting to one or two in a preparation ; but, as many as 10 to 20 were discovered in some preparations.

The presence of the embryos in the circulatory system does not give rise to any serious symptoms of disease. The author gives details regarding seven cases. Often they were found in the blood of animals in apparently good condition, but they were also found in animals that were debilitated or had become affected with a prevailing local disease. Frequently the presence of the parasites was associated with trypanosomiasis, especially in Guinea and Senegal (*T. dimorphon* trypanosomiasis). In horses not affected with trypanosomiasis the presence of the embryos, when they were few in number, is not revealed by any manifest symptom. But, the author asserts that in cases of this kind petechiae can almost always be seen on the conjunctival mucous membrane. These petechiae were seen in such horses in

certain districts where trypanosomiasis did not exist. In all animals affected, whether to a small or very large degree, a distinct eosinophilia can be noted (amounting to 7–9 per cent., whereas in the normal horse only 4–7 per cent. of the leucocytes are eosinophiles); in trypanosomiasis the eosinophile content is diminished.

When the embryos are numerous they are capable of setting up a poor general condition and external local lesions—symptoms which are analogous to those seen in the chronic forms of trypanosomiasis, but of slower development. One may thus observe in an affected animal progressive anaemia accompanied by loss of condition. There are no marked febrile crises similar to those seen in trypanosomiasis and the temperature remains almost always normal. The appetite is maintained, there is no paresis of the hind quarters, or locomotory derangement. Local lesions took the form most frequently of petechiae on the conjunctiva and often of oedematous swellings of the dependant parts—under the breast and abdomen—hot and painful swelling of the extremities of the limbs, usually the hind limbs, with resulting formation of abscesses on the lymphatic vessels. In one case a horse was seen affected with a number of quickly disappearing hot painful firm swellings. Various forms of dermatitis were also seen such as ulcerating sores, pustular eruption on the cannons similar to that seen in grease, together with cracked heels and sloughing of the coronary band (one case), and localised or generalised cutaneous eruptions resembling urticaria.

The oedematous swellings, abscesses on the lymphatics of the limbs, and the eruptions were seen on horses infested only with microfilariae, but they were also seen on others infected simultaneously with *T. dimorphon* and Oxyuris worms and it would be difficult in these cases to assign the symptoms to any one of the parasites. Contrary to what has been stated by PÉCAUD the author maintains that oedematous swellings are frequently seen in horses affected with *T. dimorphon*, but these swellings are less persistent, more doughy, and less hot and painful, especially on the limbs, than those which seem to be due to the microfilaria, while abscesses on the lymphatics and the cutaneous lesions were never seen in trypanosomiasis. An oedematous swelling of the synovial sheaths is extremely common in West Africa and is seen in animals infected or non-infected with trypanosomiasis; it was also seen in animals affected with filariasis. In a case where it is doubtful whether the disease is trypanosomiasis or filariasis one may, after making a microscopic examination, have to resort to inoculation of experimental animals, such as the goat and sheep, which are susceptible to *T. cazalboui*, in order to eliminate trypanosomiasis and assign the disease wholly to microfilariae. In cases where simple microscopic examination of blood for the embryos has proved negative it may be necessary to examine for them after centrifuging about 10 c.c. of the blood.

Treatment.—The various products utilised in the treatment of trypanosomiasis were studied. Precipitated orpiment administered in increasing doses of from 10 to 30 grammes, in two series of tests, did not bring about the disappearance of the parasites, or a diminution in their number, or any abatement in the symptoms. Atoxyl, trypanblue, trypan-red, and a combined atoxyl-orpiment treatment

likewise gave negative results. The atoxyl was injected subcutaneously in doses of 2·5 grammes for fear of accident.

Tartar emetic appeared to give decidedly superior results. The author gives details of five cases treated with this drug; in three cases the microfilariae were present alone, in two cases it was associated with *T. dimorphon*; three subjects were infested with Oxyuris. It would appear that affected animals can be injected without danger every second day with a dose not exceeding 1·2 to 1·4 grammes (according to the size of the horse). It is recommended to test the susceptibility of the animal to the drug by a preliminary injection of from 0·5 to 0·6 gramme. After repeating the injections from four to 12 times, the embryos were completely destroyed and did not recur, while the local and general symptoms gradually disappeared. One or two injections only of the drug, however, did not produce any good effect.

TREADGOLD (C. H.). **On a Filaria, *Loa papionis* n. sp., Parasitic in *Papio cynocephalus*.—*Parasitology*.** 1920. March. Vol. 12. No. 2. pp. 113–135. With 1 coloured plate comprising 7 figs. & 1 plate comprising 3 figs.

In this paper Treadgold gives a very full description of a microfilaria seen in the blood of the yellow baboon (*Papio cynocephalus*). Before the war these animals were imported in considerable numbers by Dr. L. C. QUÉRY, of Paris, who organised their capture by native hunters in the interior of French Guinea and their shipment from the port of Conakry. On arrival in Paris they were utilised by him for the production of his anti-syphilitic serum. The larval and adult forms of a filaria belonging to the genus *Loa* were identified in a certain proportion of the animals and the problem as to their identity or otherwise with the human parasite *Loa* (*Microfilaria*) *loa* investigated. The principal differences between the human and the baboon parasite are given in the following table :—

Summary of chief differences between *Loa loa* and *L. papionis*.

I. The adults.

External measurements in mm.

	♂		♀	
	Length	Maximum breadth	Length	Maximum breadth
L. loa (Penel's figures, 1904)	25–34	0·273—0·43	45–63	0·38—0·49
L. papionis	27–33	0·4—0·5	63–83	0·55—0·7

Maximum thickness of cuticle in microns.

	♂		♀
L. loa Looss (1904)	9–12	..	9–12
L. papionis	10–12	..	16–20

Breadth of lateral bands in microns.

	Breadth of lateral band at base of cephalic cone	Breadth of short distance behind base	Breadth at termination of oesophagus.
L. loa (Looss's figures, 1904) ..	♂ 9	—	63
	♀ 9	—	90
L. papionis ..	♂ 20–35	10—15	50—60
	♀ 40–60	20—34	80—100

II. The Larvae.

	Microloa loa.	*Microloa papionis*
Sheath	Present	Usually absent
Measurements in microns (Fresh material)	210-280 × 7-7·5 Low (1911)	270-330 × 6·5-7
Shape	—	Posterior extremity rather more pointed
Subcuticular cells ..	numerous	Scanty
Central viscus	Seldom seen	Frequently present
Periodicity	Diurnal	No diurnal periodicity

The following comparison of the principal biological phenomena of the human and baboon parasites is made.

"A short account of *Loa loa*. This parasite has been known in equatorial Africa for hundreds of years. The adult worm is usually found under the skin, where its presence may give rise to localised and temporary oedemas—the so-called 'Calabar swellings'; it is sometimes met with in the eye—more especially under the conjunctiva—and in these situations is also liable to cause local symptoms. After the death of the host it is usually met with under the skin, but has been occasionally discovered in the pericardial and peritoneal cavities; its presence in the cranial cavity has also been reported by Brunetiere (1913) who suggests the possibility of its having been the exciting cause of an attack of hemiplegia. Infection in man is usually associated with a considerable degree of eosinophilia, 40 to 50 per cent. of eosinophiles being quite common. As a rule, the larvae are only found in the peripheral circulation during the daytime, but this diurnal periodicity may be lost under certain abnormal conditions. Three to four years are supposed to elapse between infection and the appearance of the larvae in the blood of the definitive host. The larvae have been shown by Leiper (1912) to undergo a further stage of development in the salivary glands of certain West African tabanid flies belonging to the genus *Chrysops*; these flies bite exclusively during the daytime.

"The distribution of *Loa papionis* in *P. cynocephalus*. Adult *L. papionis* were found in ten out of 55 autopsies. Their favourite haunts were the subcutaneous tissues overlying the serratus magnus, the trapezius and the upper part of the latissimus dorsi muscles, together with the axillary folds and the region of the neck; I seldom noticed them in the inguinal or public regions or under the skin of the limbs, and never succeeded in finding them either in or near the eyes or in the serous cavities. However M. Bruck, who had previously performed several hundred autopsies on these animals with a view to excluding the presence of tuberculosis, etc., showed me the parasites he had found and gave me the filariae for identification. Six out of the seven were Loas; three of them were found in the subcutaneous tissues, while the remaining three came from the pericardium, the peritoneal cavity and the upper surface of the diaphragm respectively; the seventh was found between the layers of the mesentery and did not belong to the genus *Loa*.

The distribution of *Microloa papionis*.—When larvae were discovered in the peripheral circulation of the host during life, they were invariably present at night; they were less numerous or absent in the daytime.

In five animals in which the peripheral blood had been examined with negative results during life, larvae were found in the hearts blood at the autopsy.

In another case, no larvae were found either during life or at the autopsy; nevertheless Dr. QUÉRY exposed an adult Loa under the skin of the neck when bleeding the animal, while two more were found at the autopsy after a prolonged search. No larvae were discovered in citrated and centrifuged blood from the heart and carotid artery, and smears made from the lungs and other organs were also negative. The worms proved on examination to be full grown but unimpregnated

females. These facts are interesting in that they possibly explain a point raised by Low (1913) as to the "occasional absence of larvae from human blood in cases where adult females are known to be present in the tissues."

At the autopsy, the larvae were chiefly concentrated in the heart, lungs and large pulmonary vessels: it is possible, however, that the preliminary bleeding of the host affected their distribution to some extent. In the two animals in which a careful search was made, the distribution of the larvae was identical; on the whole they were most numerous in blood from the heart.

The microfilariae were found in the blood of 13 out of 55 baboons examined.

Summary.—"*Papio cynocephalus* from French Guinea frequently harbours *Loa papionis* n. sp. The intermediate host is unknown. The larvae, in contradistinction to those of the human parasite *Loa loa*, show no diurnal periodicity.

"The occurrence of bacterial disease in adult *L. papionis* would seem to be a novelty; at any rate I could find no mention of diseased filariae in the literature.

"In so far as the biology of *Microloa loa* is concerned, I am inclined to doubt the correctness of the opinions expressed by Rodenwalt and Fülleborn concerning the structures they term 'executory and genital cells': the current hypotheses concerning the significance of these structures and of the 'central viscus' clearly need revision. Manson's 'buccal apparatus' would seem to be nothing more than an optical illusion, while the 'neck' or 'shoulder' described by the older observers as existing in adult *L. loa* after fixation, was evidently due to imperfect technique.

"I have drawn attention to the desirability of standardising the technicalities which are such essential preliminaries to the accurate mensuration of microfilariae, and have suggested a method which has certain advantages over those at present in use.

"Concerning the pathology of *Loa* infection, evidence both of the traumatic and toxic action of *L. papionis* on baboons, was obtained; moreover, these parasites seemed definitely toxic for guinea-pigs, although the single experiment performed needs confirmation. The available evidence favours the supposition that adult baboons from an infected area possess a high degree of immunity both against *L. papionis* toxaemia and against reinfection by these parasites; but whether their serum is of therapeutic value for human beings infected with *L. loa* requires further investigation."

Boulenger (Charles L.). i. **Sclerostomes of the Donkey in Zanzibar and East Africa.**—*Parasitology.* 1920. Jan. Vol. 12. No. 1. pp. 27–32. With 5 text-figs.

——. ii. **On some Nematode Parasites of the Zebra.**—*Ibid.* 1920. March. Vol. 12. No. 2. pp. 98–107. With 7 text-figs.

i. Two collections of helminths were received for study by the author, each of which included a number of nematodes from the donkey. The first of these collections was obtained from Aders (W. M.), Economic Biologist of the Zanzibar Government, and the second from Montgomery (R. E.), late of the Veterinary Pathological Laboratory, Nairobi, British East Africa.

Nine species were observed including two hitherto undescribed :—

1. *Strongylus vulgaris* (Looss).
2. *Strongylus edentatus* (Looss).
3. *Strongylus asini*, sp. n.
4. *Triodontophorus intermedius* Sweet.

5. *Cylicostomum auriculatum* (Looss).
6. *Cylicostomum coronatum* (Looss).
7. *Cylicostomum bicoronatum* (Looss).
8. *Cylicostomum alveatum* (Looss).
9. *Cylicostomum adersi* sp. n.

The worms numbered 1 to 3 were found in both collections, Nos. 4 to 8 were found in the East African collection only, while No. 9 was found in the Zanzibar collection only.

The newly-described species *Strongylus asini* was found in a cyst of the liver and in the caecum of the donkey from Zanzibar, and in the caecum of the donkey from Nairobi. The species was a large form, 18 to 42 mm. long by 1·8 to 2·5 mm. in maximum breadth and it seems to occupy a position intermediate between *Strongylus equinus* (Looss) and *S. edentatus* (Looss). The rays of the bursa were similar to those of the latter species, i.e., they were more slender than those of *S. equinus*. The branches of the posterior rays differed from those of the other species in that the inner dorsal branch was simple and the external branch divided, that is, the converse of the arrangement prevailing in the genus.

Cylicostomum adersi, represented by a single male specimen only, found in the caecum of a donkey from Zanzibar, appeared to be closely allied to *C. insigne*, but was distinguishable from this worm by the character of its genital appendages, by the number and shape of the leaves of the internal leaf-crown and the presence of a highly chitinized oesophageal funnel.

ii. The zebra worms examined by the author formed part of a collection of helminths forwarded by MONTGOMERY (R. E.), from British East Africa. Although the specimens were not numerous they included representatives of eight species, three hitherto undescribed, one of which is taken as the type of a new genus :

1. *Strongylus vulgaris* (Looss, 1900).
2. *Cylindropharynx brevicauda* Leiper, 1911.
3. *Cylindropharynx longicauda* Leiper, 1911.
4. *Cylicostomum minutum* Yorke & Macfie, 1918.
5. *Cylicostomum zebrae* sp. n.
6. *Cylicostomum montgomeryi* sp. n.
7. *Triodontophorus serratus* (Looss, 1900).
8. *Craterostomum tenuicauda* gen. et sp. n.

The species numbered 1, 4 and 7 are also parasites of the domesticated equines. It was pointed out by LEIPER, (1911), that the nematodes parasitic in the zebra consist of a number of species which also occur in the domesticated equines besides others peculiar to the zebra itself. It is stated that among the bursate forms of the latter perhaps the most interesting are those which LEIPER includes in the genus Cylindropharynx.

Both the known species of this genus were found in the collection received from MONTGOMERY ; besides describing two new species of Cylicostominae the author somewhat amplifies LEIPER's descriptions of these species.

The genus *Craterostomum* with *C. tenuicauda* as type species is said to be closely allied to *Triodontophorus* Looss, differing from this genus by the absence of teeth projecting into the mouth-capsule.

The type specimens, which consisted of three females only, were small rather robust worms 4 to 5·5 mm. in length and nearly ·4 mm. in maximum breadth, but reduced to ·28 to ·32 mm. at the level of the termination of the oesophagus.

Cylicostomum zebrae from its morphological characters falls into the group of species which includes *C. auriculatum* Looss, *C. elongatum* Looss, and *C. insigne* Boulenger, agreeing with these in the general formation of the head and in the structure of the male bursa and its appendages. It differs chiefly from these species in the shape of its oesophagus, which has an enlarged anterior extremity and in the greater development of the oesophageal funnel.

Cylicostomum montgomeryi differs from all other known species of Cylicostomum with the exception of *C. falciferum* (Cobbold, 1882) in the structure of its mouth capsule, which is characterised by its peculiar bi-lateral symmetry, its dorsal and ventral walls being considerably higher than the lateral walls; this absence of radial symmetry makes an optical section of the head in a lateral view present a totally different appearance to that viewed dorso-ventrally. It is pointed out that *C. falciferum*, a parasite of the elephant, has now been placed in a separate genus *Murshidia* Lane, 1914; the bi-lateral symmetry in this species extends to the elements of the leaf-crown whereas in *C. montgomeryi* those structures are radially arranged.

SHEATHER (A. L.) & SHILSTON (A. W.). *Syngamus laryngeus* **in Cattle and Buffaloes in India.**—*Agric. Res. Inst., Pusa, Bull. No. 92.* 1920. 8 pp. With 8 plates comprising 28 figs. 1920. Calcutta: Supt. Govt. Ptg., India. [Price As. 6.]

The only record of a Syngamus in cattle is that of RAILLIET (1899), who described the occurrence of these parasites in cattle in Annam.

It appears that the parasite was identified in cattle in Muktesar in 1897, but no description of it was published. In 1916 it was observed by Shilston and again in 1918 by Sheather in hill bulls and buffaloes used for the production of rinderpest virus and in plains cattle of various ages and of both sexes killed in the slaughterhouse at Bareilly. The parasites were found in about 13 per cent. of buffaloes and hill bulls and 15 per cent. of plains cattle. The maximum number found in one animal was 17 in hill bulls, 24 in buffaloes, and 16 in plains cattle; generally, however, only one or two were found.

In nearly all these animals the parasites were found attached to some part of the interior of the larynx. In the first case examined symptoms of coughing and loss of condition were noticed for a few days. The animal then died suddenly, probably as the result of the treatment involved in the manufacture of haemorrhagic septicaemia serum, and on post-mortem examination the mucous membrane of the pharynx was found to be congested; adhering to it and the back of the soft palate there were about 10 or 12 pairs of worms and a few were also found attached to the mucous membrane of the larynx. No disturbance in health was noted in any other infected animal apart from this special case. Evidence showed that the buffaloes had

become infected in the plains prior to their admission into the Laboratories at Muktesar or Bareilly. Both cattle and buffaloes are affected and age does not seem to be a predisposing factor.

RAILLIET'S measurements were:—Males 3–3·375 mm. by 360–375μ, females 8·7–9·8 mm. by 550–570μ. The authors' specimens measured: males 3–5 mm. by 340–375μ, females 7–20 mm. by 450–675μ. These measurements represent many of the worms discovered in India as being at least twice as large as those examined by RAILLIET. The male was of almost uniform thickness throughout its length and it was always found attached to the female; the latter attained its maximum thickness around the vulva and tapered slightly towards the head and the tail; the tail extremity was in the form of a "sub-acute point."

The authors then proceed to describe in detail the morphology of the adult parasites and the various points in their description are well illustrated by numerous figures.

Syngamus (*S. trachealis*) parasites, as is well known, are frequent parasites of the respiratory tract of birds and cause the condition known as "gapes" in fowls.

HALL (Maurice C.). **Studies on Anthelmintics. iv. Experiments with Combinations of Oil of Chenopodium and Chloroform.**—*Jl. American Vet. Med. Assoc.*, 1919. Oct. Vol. 56. (New Series Vol. 9.) No. 1. pp. 59–70.

——, & WIGDOR (Meyer). **v. The Administration of Oil of Chenopodium in Soft, or Soluble Elastic, Gelatine Capsules, as compared with other Modes of Administration.**—*Ibid.* Nov. No. 2. pp. 169–177.

—— & AVERY (Lawrence). **vi. The Use of Carbon Bisulphid in Infestations with Bots, Gastrophilus Spp.**—*Ibid.* Dec. No. 3. pp. 265–270.

——, **vi *a* Tests of the Administration of Anthelmintics in Enteric-coated Soft Gelatine (Soluble Elastic) Capsules.**—*Ibid.* pp. 310–316.

——, & WIGDOR (Meyer). **vii. A Comparison of Castor Oil and other Purgatives in Connection with the Administration of some Anthelmintics.**—*Ibid.* 1920. Jan. No. 4. pp. 394–399.

The first three sections of the experimental work upon worm remedies performed by Hall and his collaborators have already been extracted in this *Bulletin* [1919, Vol. 7, No. 4, p. 210].

iv. The question as to whether a combination of oil of chenopodium and chloroform might be a valuable one has previously been discussed by Hall and FOSTER [this *Bulletin*, 1918, Vol. 6, No. 2, p. 105]. In the present paper Hall describes a considerable number of experiments upon dogs infested with worms, using combinations of these drugs.

It was concluded that the best results in the removal of hookworms after employing a treatment which involved the administration of one dose only was obtained by giving oil of chenopodium in a dose of about 0·1 c.c. per kilo body weight. Quantities of the drug as near this dosage as possible were given by administering it in 5 or 10 minim soft or soluble elastic capsules. The dogs were then immediately given 30 c.c. of castor oil containing chloroform, in a dose corresponding with 0·2 c.c. per kilo body weight of the animal;

the chloroform might otherwise be given in hard gelatine capsules. The efficiency of this method of treatment appeared to depend upon the consecutive action of the drugs, which in a manner resembled treatment by repeated doses, inasmuch as chloroform in castor oil acts very rapidly against the worms whilst the chenopodium exerts its action only subsequent to its release from the soft capsule after a certain interval of time.

This method of treatment proved to be "87·5 per cent. effective" in tests upon 15 dogs, of which 6 had hookworms. It was "97 per cent. effective" against ascarids in tests on the same number of dogs, of which 9 were infested with these worms. On the other hand, the method proved comparatively ineffective against whipworms, which necessitated the employment of repeated doses. It was also ineffective against tapeworms, but previous work had already shown that neither of these drugs can be relied upon to act against these worms.

Experiments in which dogs were treated with 5 or 10 minims of chenopodium in soft capsules at hourly intervals together with 15 c.c. of castor oil each time and then given 4 c.c. of chloroform in 15 c.c. of castor oil 1 to 1½ hours later gave very satisfactory results. The method proved "91 per cent. effective" against hookworms in tests upon three dogs infested with these worms; it was "100 per cent. effective" in tests upon 2 dogs infested with ascarids.

These results are in accordance with those claimed to have been obtained by SCHÜFFNER and VERWOORT in the treatment of human hookworm infestations in Sumatra. They gave three doses of oil of chenopodium in 16 minim doses on sugar at hourly intervals and 2 hours after the last dosing they gave 17 grammes of castor oil and 3 grammes of chloroform. Hall's experiments are held to indicate that there is less danger to the patient when each dose of chenopodium is given together with a dose of castor oil.

The administration of chenopodium and chloroform simultaneously by giving a soft capsule containing these two drugs in the proper proportion is stated to be unsatisfactory. When given in a single dose the combination is not sufficiently effective and in repeated doses it is less effective against hookworms, against which the combination is intended, than a single dose in which the chenopodium only is administered in the soft capsule. Against whipworms the use of repeated doses is accompanied by an increased efficacy but such a method involves a higher degree of injury to the gastro-intestinal mucous membrane.

v. Hall and Wigdor's numerous experiments on dogs indicated that the soft or soluble elastic capsules, which were used as convenient receptacles for administering oil of chenopodium, opened in the stomach and not in the small intestine of the animals; the considerable efficacy displayed by the oil against ascarids and hookworms when administered in this way also lent support to this view; the simultaneous administration of purgatives appeared to hasten the rupture of the capsules. When purgatives were not given the capsules lay in the stomach for up to 1 hour 21 minutes, and they appeared to undergo digestion in from 1 to 2 hours. When purgatives were given the capsules were partly or completely digested in 30 minutes. Chenopodium could be detected in the intestines in 1 hour 30 minutes when

purgatives were not given, and in 30 minutes when they were given. The increased rapidity with which the capsules became ruptured when a purgative was given was probably due to the mechanical action of increased peristalsis on the softened moist capsule and the increased secretion of digestive fluids. When given in soft capsules chenopodium may remain in the stomach for 1 hour 45 minutes, when given without purgative, or 2 hours 7 minutes when given with a purgative. The drug can be detected in the small intestine in 1 hour 4 minutes when given without purgatives, or in 1 hour 30 minutes when given with purgatives.

vi. The carbon bisulphide treatment for the removal of bots from horses was first proposed by PERRONCITO and BOSSO in 1894, and has since been advocated by many writers as the result of clinical observation. Hall, SMEAD, and WOLF (1919) published the results of experimental work which confirmed the views held upon the reliability of the drug. Further tests are described in this paper which were carried out in order to ascertain the minimum effective dose. It appeared that all bots present in the stomach and duodenum could be removed by the use of a single dose of 6 drachms. The same result could be obtained by the use of repeated doses, viz., 2 doses of 4 drachms each given at an interval of 2 hours, or 3 doses of 3 drachms each at 1 hour intervals. Moreover, the carbon bisulphide was observed to produce this effect when given without a purgative, or when a purgative was given several hours before or after the treatment. The administration of a single dose involves the use of a smaller total quantity of the drug and a saving of time; but, the use of repeated doses gives one an opportunity to suspend treatment if untoward results are evident after giving the first dose. It is thus advisable that these doses should not be exceeded.

When given in 4 or 5 drachm doses the drug was found capable of removing all bots of the species *Gastrophilus intestinalis* from their usual seat of attachment in the cardiac portion of the stomach, but some or all of those belonging to *G. nasalis* were left behind. The minimum effective dose must therefore be regarded as corresponding with those enumerated in the preceding paragraph.

Linseed oil administered within ½ hour after the carbon bisulphide greatly diminishes the efficacy of the drug against bots and ascarids. The use of linseed oil is therefore not recommended, for while it in no wise appears to lessen danger it may sometimes cause super-purgation.

vi *a*. Anthelmintics intended to remove worms from the small intestine become partly absorbed in passing first through the stomach; systemic effects are thereby produced, a smaller quantity remains available for acting directly upon the worms, and the drug reaches the intestine diluted with the stomach contents. Some method of enclosing the drug so that it is not liberated until it reaches the duodeneum is therefore indicated, but in practice the materials used for the manufacture of the so-called enteric capsules have not proved altogether satisfactory. Such materials, which are said to be comparatively insoluble in gastric juice, are talc-shellac, phenyl salicylate, keratin, and formalin-hardened gelatine, but there are various objections to all of them. In Hall's experience, talc-shellac coatings will open sometimes in the stomach, or sometimes fail to open in the upper

portion of the small intestine, while formalin-hardened gelatine gets progressively harder with age and ultimately fails to open at all and eventually passes unopened right through the digestive tract. However, "tests of soft capsules containing oil of chenopodium and coated with the talc-shellac preparation gave entirely satisfactory anthelmintic results." A number of experiments on dogs which lend support to this view are described. Reference is made to work performed in the same direction by ZIEGLER (1917), who used hard capsules covered with a coating of salol, but Hall refuses to concur with that author's views that the most rational method of administering chenopodium in hookworm infestation is by placing it in the "enteric capsules." The anthelmintic efficacy of the drug given in soft capsules with talc-shellac coats was well maintained, especially towards ascarids, but even these capsules were sometimes found to pass along as far as the ileum without opening.

vii. Opinions are divided as to which is the best purgative to use with oil of chenopodium; the two drugs employed mostly are magnesium sulphate or castor oil. The experiments performed by Hall and Wigdor showed that castor oil was highly satisfactory. It was endowed not only with purgative properties but it also exercised a protective action. It was found that the lives of animals that had been given lethal doses of oil of chenopodium could be saved if castor oil were administered simultaneously or up to 1 hour afterwards. In like manner, animals that had been given lethal doses of oleoresin of male fern could be saved when castor oil was given with the drug.

Calomel was also found capable of saving animals that had been given lethal doses of male fern. Liquid petroleum (paraffinum liquidum) was found to afford but little protection against lethal doses of chenopodium and diminished the anthelmintic efficacy of the drug. Olive oil seemed to retard the passage of the chenopodium from the stomach and to increase gastric absorption, while it did not protect against lethal doses. The amount of work performed by the authors upon magnesium sulphate is not considered sufficiently extensive to formulate a definite opinion, but their belief is that it is not well suited to dog practice.

WISLOCKI (George B.). **Observations on *Dioctophyme renale* in Dogs.**—*Jl. Parasit.* 1919. Dec. Vol. 6. No. 2. pp. 94–97.

In 3,200 dogs of all ages, breeds, and sizes, examined post-mortem by the author at Washington, D.C., U.S.A., *Dioctophyme renale* (*Eustrongylus gigas*) was found in 12 (=0·37 per cent.). Five of the hosts were males and seven were females. Two of the dogs contained more than one worm; the majority of the worms were females. In all infested dogs the worms were found free in the peritoneal cavity and only twice was it possible to trace a port of entry, through a partially destroyed kidney. The peritoneal lesions were: Constant injury to the peritoneum, associated with escape and absorption of blood, the irritating effect of the worm's excreta and ova producing a chronic peritonitis. A dirty brown or greenish odourless exudate of a fibrinous character was observed in places clinging tenaciously to the roughened peritoneal surface. The omentum was often matted together with exudate and frequently adhered so intimately to the liver, spleen,

pancreas, and intestines that it was difficult to disentangle them. The mesenteric, preaortic and mediastinal lymphatic glands were enlarged and deeply pigmented. Fibrous scars and adhesions were occasionally noted on the spleen and liver. Microscopic examination of the thickened omentum or peritoneal surfaces showed them to be covered with a cellular exudate composed of polynuclear leucocytes and mononuclear cells among which numerous ova were imbedded. The ova were slowly disintegrating under the action of one or more giant cells, with which each of them was surrounded. The cytoplasm of many of the mononuclear cells contained particles of debris and pigment.

Interest attaches to this parasite on account of its occasional occurrence in man. It has been suggested that it probably passes part of its life cycle in another host, probably a fish (Balbiani, 1870). The worms have also been described in the wolf, martin, mink, seal, and other mammals. Geographically, they have an almost universal distribution. A summary of the observations made upon this worm by other workers is given.

Musso (L.). **Traitement de la gale du dromadaire par le goudron de coloquinte (Deuxième note).** [Treatment of Mange in the Dromedary by means of Colocynth Tar.]—*Bull. Soc. Path. Exot.* 1920. Jan. 14. Vol. 13. No. 1. pp. 29–34. With 2 text-figs.

On account of its extreme susceptibility to chills the dromedary cannot be treated for mange by any methods which involve considerable wetting of its coat. It was thus resolved to make a study, at the Pasteur Institute, Algiers, of the traditional method adopted by the nomad tribes of Northern Africa, which consists in the application of a wood tar obtained by distilling plants of the species *Juniperus phoenicea* and *Tuya articulata*. A tribe known as the Tuareg employ tar extracted from colocynth seeds and a sample of this was obtained for analysis. The product was in the form of a black liquid which, when allowed to stand, separated slowly into three layers, viz., a lower layer denser than water and equivalent to about $\frac{1}{10}$th of the total bulk, an intermediate, watery, layer, equivalent to about $\frac{6}{10}$th of the bulk, and an uppermost layer consisting of actual tar and forming about $\frac{3}{10}$th of the total volume. The lowermost and uppermost layers had a thick viscid consistence, so that even after several months the layers were not completely separated into three layers. The native usually employs the mixed product, especially after it has been preserved in skins, but, on the other hand, when kept in a tank it is probably often used without mixing. Perhaps the curative properties do not reside completely in the uppermost, tarry, layer, and the aqueous liquid, which is deeply coloured and acid in reaction, may have some therapeutic effect. A detailed chemical analysis of the tarry layer was made by the author.

The natives gather the colocynth fruits when ripe and very dry. They are then placed in a heap and beaten with sticks in order to break the spongy envelope and the whole mass is winnowed so as to isolate the seeds.

The distilling apparatus the author recommends consists of two metallic cylinders about 10–15 litres in capacity, one of which is slightly

smaller in diameter than the other so that it can be telescoped within it, and both are closed at one end. The cylinder with the smaller diameter is filled with seeds up to about 10 cm. of its upper, open, end and the seeds are covered with palm leaf and then with a disc perforated with holes about 3 mm. in diameter and kept in position by hooks. This smaller cylinder is then inverted and introduced into the larger one and lowered until the mouth of the larger one is at the level of the seeds in the smaller one. The cylinders are placed in a vertical position and held together by means of small strips of tin. Clay mixed with sand is used to seal up the joint where they meet. The apparatus is then placed in a fairly deep hole dug in the sand so that it is buried up to 5 cm. above the clay union. The lower cylinder is thus protected from heat by the sand. Above this level a sort of large stonework basin is made with the upper cylinder full of seeds at its centre. In this basin a fire is made, first by burning some wood and then large quantities of dried dromedary dung or cow dung, which burns slowly and produces a strong more or less constant heat. After about 12 hours the fire is put out and the apparatus allowed to cool. In this manner 15 litres of seeds yield about 4 litres of crude tar. The method used by the natives themselves is similar except that they employ cylinders made of earthenware.

According to the Sahara peoples colocynth tar is particularly effective in the treatment of dromedary mange and its use appears preferable to that of other tars; one application often gives good results whilst if applied a second time even the most severely affected dromedaries are completely cured.

NUTTALL (George H. F.). **On Coloration in Ticks. II.**—*Parasitology.* 1920. Jan. Vol. 12. No. 1. pp. 1–6. With 2 coloured plates comprising 10 figs.

Summary and Conclusions.—"The coloration of *Amblyomma hebraeum*, *A. gemma*, *Dermacentor venustus*, *D. variabilis* and *D. reticulatus niveus*, as seen in living examples, is depicted for the first time, and the desirability of recording the colours of ornate ticks when alive is indicated.

"A remarkable change in colour in living specimens of *A. hebraeum* is described and figured, this change taking place after a prolonged sojourn (74–141 days) upon the host. Such a colour change has not hitherto been observed in ticks. The difference in colour is seen in dead dried specimens but is not appreciable in those preserved in alcohol.

"Since the immature stages of ornate ticks are inornate, and the colours change in adults of some species during prolonged periods of parasitism, it is evident that the coloration in adults must depend upon the accumulated products of metabolism beneath the chitinous exoskeleton, the regional distribution of colour depending upon special metabolic functions taking place in corresponding parts of the tick. The ornamental colour-producing layer can be scraped away from the underside of the scutum in most ornate ticks and it is removable from such ticks by the use of caustic potash.

"The whitish or creamy coloration that is so characteristic of most species of *Dermacentor* and the three ornate species of *Rhipicephalus* that are known to science, appears on the other hand to depend largely upon inclusions or structural changes within the chitin itself, whence the persistence of the creaminess seen by reflected light in the caustic-treated ticks. Similar, but less distinct, appearances may be seen in ticks belonging to other genera. *Dermacentor rhinocerotis*, which does not exhibit creamy coloration but only dull yellowish spots when dry, is totally decolorized by caustic potash, whilst contrary to most species of its genus it shows metallic coloration in well-preserved specimens in alcohol.

"The examination of caustic-treated specimens was carried out upon 31 species of ornate ticks, i.e., *Dermacentor* (8), *Rhipicephalus* (3), *Amblyomma* (15), *Aponomma* (4), and *Hyalomma* (1 species).

"The coloration and creamy ornamentation, herein distinguished appear to be confined to the thinner portions of the exoskeleton. That the characteristic dark markings correspond to thicker and more darkly chitinised portions of the scutum is demonstrable by dissections, caustic treated, or sectioned specimens; this being especially evident for instance in *Amblyomma*. The orange spot of the scutum of *A. splendidum* offers an exception.

"The optical and chemical study of coloration in ticks deserves further investigation."

NUTTALL (George H. F.). **Regeneration of the Mouthparts and Legs in Ticks.** *Argas persicus, Amblyomma hebraeum* **and** *Hyalomma aegyptium.—Parasitology.* 1920. Jan. Vol. 12. No. 1. pp. 7–26. With 6 text-figs.

Summary and Conclusions.—"Amputation experiments upon immature stages of *Argas persicus* (Oken 1818), *Amblyomma hebraeum* Koch 1844, and *Hyalomma aegyptium* (Linnaeus 1746) show that the mouthparts and legs of these ticks may be more or less regenerated when mutilated shortly after the ticks have abandoned the host in a fully engorged condition.

"Regeneration of mouthparts. In immature *Argas persicus* the mouthparts are regenerated more or less perfectly according to the structure affected and the stage of development of the tick. Freshly gorged larvae regenerate their mouthparts badly compared to first and second-stage nymphs because during their period of parasitism upon the host (5–6 days usually) the larvae have advanced well along the road to becoming nymphs, therefore the operation largely affects the formative tissues of the developing nymph. The nymphs feed rapidly, usually in 15–20 minutes, and proceed with their metamorphosis after abandoning the host, consequently, when they are mutilated soon after feeding, they regenerate their mouthparts (and legs) better than do the larvae. After operations on larvae and first-stage nymphs regeneration takes place best in the hypostome, next in the chelicerae and least well in the palps. This order was reversed after similar operations on second-stage nymphs. The power to regenerate palps and chelicerae grows as the tick approaches maturity, but it remains fairly constant for the hypostome. Amputations made through the basis capituli usually render the tick incapable of feeding after it has moulted to the next stage, the mouthparts not having been adequately regenerated. In one case (*Argas* 72), however, the amputation of the anterior part of the capitulum with its appendages in a second-stage nymph was followed by almost perfect regeneration of the part in the succeeding third-stage nymph. Where regeneration did not take place adequately after severer operations on the basis capituli, as exemplified in another case (*Argas* 73), the mutilated tick lived on without its capitulum for four years without a meal. This experiment explains the origin of the anomalous "headless female" of *Ixodes ricinus*, referred to and figured by Wheler, which lived four years and was lost. Lesser mutilations, i.e., those affecting the appendages only, are frequently followed by perfect regeneration if the injury is slight. Imperfectly regenerated parts are often capable of functioning so that the tick can feed. Such a tick, if not interfered with, will acquire perfectly normal mouthparts at the next moult.

"The immature stages of the Ixodid ticks *A. hebraeum* and *H. aegyptium* behave differently to *Argas persicus* when injured soon after abandoning the host, in that they possess much greater powers of regeneration. Basal or partial amputations of the hypostome and palps, or moderate mutilations of the chelicerae, are followed by perfect regeneration in most cases.

"The greater power of regeneration possessed by Ixodid ticks bears directly upon their parasitic habits. The slowly feeding larval stages of Argasids (*A. persicus, A. vespertilionis*, for example) possess relatively

more dentate hypostomes than do the adults which are rapid feeders. With the exception of *Haemaphysalis concinna* (vide Brumpt's observations recorded by me in *Parasitology*, vii, 434) all known Ixodids are slow feeders and an examination of genera like *Ixodes*, *Amblyomma* and *Hyalomma* proves that their hypostomes are most efficient organs for anchoring the tick to the host . . . . The capitulums of *A. hebraeum* and *H. aegyptium* females . . . . possess long, highly dentate hypostomes broadening distally and liable to break where they narrow toward the base when violence is done to the tick that is fixed thereby to the skin. The examination of such Ixodid ticks collected in the field proves how frequently their long hypostomes get broken off near the base, and consequently how vital it is that they should be readily regenerated. Whilst a tick may save its digits by moving and retracting them, it cannot do so with its hypostome which is a rigid structure whose chitin is continuous with that forming the basis capituli. The hypostome is the most readily regenerated element of the mouthparts because it consists almost entirely of chitin, its formative tissues lying beneath the stout chitinous base whilst it is developing in the immature stages prior to a moult. In this position, the formative tissues are not liable to be hurt, whereas in the case of the palps and chelicerae as with the legs, the formative tissues are more directly accessible to injury.

"The power of regenerating mutilated mouthparts possessed by immature ticks is of paramount importance in connection with their maintenance in nature where they are frequently injured through their forcible removal from the host, the hooked hypostome and digits of the chelicerae being broken off to a varying degree because they are so firmly anchored in the host's skin. Such mutilation of the mouthparts is much more likely to occur in Ixodid than in Argasid ticks because the mouthparts of the latter are as a rule less effective anchoring organs, the structure of the mouthparts in the two groups being correlated with their feeding habits upon the host.

"Regeneration of legs. The experiments with *Argas persicus* herein recorded confirm those of Hindle and Cunliffe (*loc. cit.*). If the legs of the larva are amputated shortly after the tick has abandoned the host in a fully gorged condition, the first-stage nymph usually shows stumps corresponding in length to the portion of limb that was left intact in the larva. The authors cited found, however, that if the larva had its legs amputated whilst attached and feeding on the host, i.e., 2 to 3 days prior to its dropping off in a replete state, that the legs may at times be regenerated in which case they are usually of subnormal size. When the legs of first and second-stage nymphs are amputated soon after they have fed, the limbs are regenerated but are usually small. Immature ticks with small or stumpy legs, if not subjected to further interference, develop normal limbs after a further moult.

"My experiments with *A. hebraeum* and *H. aegyptium* show that these Ixodid ticks possess greater powers of regeneration than *A. persicus* in respect to the legs, this being in harmony with the results above described in connection with the mouthparts. The number of legs amputated from the two Ixodid species in the larval and nymphal stages was 21 and all of them were regenerated; 13 limbs were of normal size and 8 slightly smaller than normal."

BACTERIAL DISEASES.

Mondd (Th.) & Velu (H.). **Quelques faits relatifs à la prophylaxie vaccinale contre le charbon bactéridien au Maroc.** [A Few Facts concerning Preventive Vaccination against Anthrax in Morocco.]—*Bull. Soc. Path. Exot.* 1920. Jan. 14. Vol. 13. No. 1. pp. 14–16.

In Chauveau's classical researches it was shown that Algerian sheep were highly resistant towards infection with anthrax of French

origin. It was reasonable to believe that sheep in Morocco belonging to the same breeds as the Algerian sheep also possessed the same degree of natural immunity. Velu has, however, shown that outbreaks of anthrax actually do occur among Moroccan sheep and believes that the anthrax bacillus causing the disease is of a considerably higher virulence than the French type of organism. [This *Bulletin*, 1919. Vol. 7. No. 2. p. 86.]

Inasmuch as the sheep possessed a relatively greater resistance towards anthrax than French sheep it was natural to suppose that the second Pasteurian vaccine could be employed to commence with for vaccination, and on these grounds the authors inoculated 11,100 sheep in 1919, without noticing any serious subsequent ill-effect. 3,750 pigs were vaccinated in the same way with the same results; but, it is well known that the pig possesses a considerable degree of natural immunity against anthrax. The authors were then led to adopt this simplified method in the vaccination of cattle, and 16,500 animals were inoculated with the second vaccine, without a single accident. It therefore seems safe to conclude, it is stated, that the indigenous cattle, sheep, and pigs of Morocco can be submitted to an initial injection with the second Pasteurian vaccine without running any risk.

Experience showed that the immunity set up following upon vaccination by the Pasteurian method in Morocco did not always last a whole year. In July 1914 some cases of anthrax were observed in Kenitra among imported Portuguese cattle; the remainder of the herd was injected with anthrax anti-serum and then vaccinated with the two Pasteurian vaccines immediately on their receipt from the Pasteur Institute. The mortality ceased, but four months afterwards fresh cases of death were produced in the remainder of the herd, which had to be slaughtered to avoid further fatalities from anthrax. At the end of February 1919 a certain herd of 200 head of cattle was vaccinated at Dar-Bel-Hamri and at the beginning of the following November cases of anthrax occurred, that is, after about eight months. Another herd in the vicinity containing about 150 head was vaccinated in March and in the following October several cases of anthrax occurred. In another district (Settat) an actual local outbreak of anthrax occurred in October among cattle that had been vaccinated during the previous December.

The authors believe that these immunity breakdowns were not due to faulty technique or to defects in the vaccine, but, on the other hand, to the greater virulence of the Moroccan type of anthrax organism. These statements, it is said, obtain confirmation in the experiences of LHÉRITIER, FLEURY, and TRIBOUT. In order thus to prolong the immunity set up by vaccination it would be necessary to repeat the process at least twice a year, either by injecting a second dose of second vaccine in double the dose ordinarily given or by injecting only a very slightly attenuated culture the second time. It is remarked that out of 31,350 animals vaccinated no case of death resulted (for some months), whereas out of 100 animals exposed to infection prior to vaccination and thus probably already infected, two died following upon sero-vaccination.

Van Saceghem (René). **L'avortement épizootique au Congo Belge.** [Contagious Abortion in the Belgian Congo.]—*C. R. Soc. Biol.* 1920. Feb. 21. Vol. 83. No. 7. pp. 187–188.

In 1919 Bruynoghe described a bacillus which was the cause of epizootic abortion among asses in the Belgian Congo. The organism was found in great abundance in the aborted foetus. Cross-agglutination tests appeared to demonstrate that the bacillus was identical with the causal agent of epizootic abortion among mares in Europe (viz., the *Bacillus abortivo-equinus.*) On the other hand, some experiments performed by Van Saceghem in the Congo appeared to indicate that the organism isolated from the asses was only capable of producing abortion in these animals and was not pathogenic for the mare. Asses of the Poitou, Lombardy, and African Moorish breeds were successfully infected whereas attempts at infecting mares and cows failed completely. At the Zambi Station 70 horses were kept for a period of three years and no case of contagious abortion was observed among them. During this period out of about 30 asses kept over one half aborted from time to time. A pregnant mare placed in contact with infected asses for seven months gave birth to a normal foal. Another pregnant mare was injected per vaginam with fluid obtained from the foetal membranes of an ass that had aborted ; the mare did not subsequently abort.

DISEASES DUE TO FILTERABLE VIRUSES.

Hadwen (S.). **Notes on Swamp Fever.**—*Jl. American Vet. Med. Assoc.* 1920. Feb. Vol. 56. (New Series Vol. 9.) No. 5. pp. 439–443.

In this short paper Hadwen states that co-operative investigations on swamp fever (infectious anaemia) in horses have been carried on for some time past by the United States and Canadian Government Departments of Agriculture. Ransom B. H. (of the U.S.A. Bureau of Animal Industry) and the author have visited affected districts in Canada and are carrying on some experiments at Washington and Ottawa.

As has also been the experience of other observers, the investigators found it difficult to decide except by blood inoculation whether they were dealing with swamp fever or verminous anaemia. The symptoms presented by a case of gross parasitism apparently resemble closely those of swamp fever. In a paper published in 1918 by Hadwen upon Canadian worms mention was made of lesions in the colon of horses presenting a close naked-eye similarity to swine fever ulcers—lesions which had been previously noticed by Weinberg in France and by Hartman in Montana. These were caused by a certain species of nematode, *Triodontophorus tenuicollis.* Other lesions, which might be mistaken for swamp fever lesions, were also encountered. For example, it was often observed that when the lymphatic glands adjacent to the kidneys were haemorrhagic and the surrounding tissues gelatinous, immature forms of Strongylus were found in the

lesions. *S. edentatus* was also found in reddened patches resembling bruises on the walls of the abdominal cavity. Intestinal lesions both external and internal have frequently been described in swamp fever. In the author's postmortems nodules and reddened oedematous patches, visible on the serous surfaces, were frequently seen and were usually found to contain larval forms of cylicostomes. Submucous nodules containing dead and degenerated parasites were also seen. The bites of *S. vulgaris* were most numerous at the blind end of the caecum while those due to *S. edentatus* and *S. equinus* were situated about the junction of the caecum and the first part of the colon ; bites in the first division of the colon were caused by *S. edentatus*. The bites corresponded in shape and size to the buccal cavity of the worms, those of *S. edentatus* being the largest and those of *S. vulgaris* the smallest.

The haemorrhagic spotting of the endocardium frequently described as a typical lesion of infectious anaemia was also a very constant lesion in the cases observed by the author in the field. However, a number of apparently healthy horses experimentally injected subcutaneously with fresh juice of worms or extracts of dried worms or bots were found postmortem to show lesions very similar to these. Such lesions have also been seen by various observers in conditions other than swamp fever. The occurrence of oedematous swellings on the abdomen, breast, and limbs in both verminous anaemia and infectious anaemia constitutes another difficulty in differentiating between these conditions; but, no evidence was obtained to indicate that infectious anaemia had anything to do with the verminous infestation. Several of the cases observed in the field were proved to have been actually swamp fever by experimental inoculation. The experimental feeding of horses with the infective stages of the parasites obtained from cultures made from the faeces of horses suffering from infectious anaemia invariably yielded negative results. Likewise injections of worms taken from horses suffering from infectious anaemia failed to reproduce the disease (with one exception in which a horse showed first symptoms of swamp fever five months after inoculation but in the meantime had been associated with infected horses). [Compare, however, DE KOCK's experiments with extracts of bots from infected horses (preceding No. of this *Bulletin*, p. 41).]

Smears were made from the blood of several infected horses and differential counts of the leucocytes made. According to many workers, including VAN ES, HARRIS, SCHALK, THEILER, MACK, and others, the mononuclear count is increased and RANSOM and Hadwen themselves also found that this sometimes was as high as 100 per cent., and usually 60–80 per cent. The increase in mononuclears is thus an important point in the diagnosis of the disease. In moribund cases, however, it was observed that the polynuclears increased in numbers until sometimes they almost resumed their normal proportion while the mononuclears were correspondingly reduced.

The eosinophiles were in many cases noticed to be diminished in number and sometimes altogether absent from the peripheral blood, an observation which has been made by others without special comment. This diminution may be due either to their displacement by other cells that are increased in number or to their withdrawal from the

general circulation and local accumulation in certain organs and tissues especially in lesions produced by parasites. Smears from verminous ulcers in the colon and the tissues surrounding the parasites in other locations show eosinophiles in enormous numbers. WEINBERG and SÉGUIN showed that verminous substances stimulated the eosinophiles to phagocytic activity. Hadwen proved that after the injection of verminous juices or extracts of dried worms subcutaneously into healthy horses the percentage of eosinophiles frequently increased—in one instance (3 days after the second injection) to 20 per cent. from an original percentage of 6·8. The normal percentage of eosinophiles in horses appears to be about 3 or 4 per cent., and natural eosinophilias as high as 20 per cent. are very rare. Natural eosinophilias in the horse are thus stated to be of a lower percentage than those commonly observed in other animals suffering from parasitic infestation. In gross verminous infestation the percentage of eosinophiles in the horse may be very low, especially if the parasitism is complicated with swamp fever.

In the study of swamp fever the author concludes that careful attention should be paid to the parasitic conditions which may complicate the disease; otherwise misleading and false deductions are very liable to be made.

WRIGHT (Lewis H.). **A Comparative Study of the Long Bones in Infectious Equine Anemia and other Conditions.** *Jl. American Vet. Med. Assoc.* 1920. Feb. Vol. 56. (New Series Vol. 9.) No. 5. pp. 444–447.

Nearly all the investigators of equine infectious anaemia have drawn particular attention to the changes occurring in the marrow of the long bones, especially the humerus and the femur. Most of these workers have come to the conclusion that these changes are more or less pathognomonic. The Japanese Commission, for example, found that the "changes of the bone marrow are very marked next to those of the blood." THEILER and KEHOE, however, in their studies upon this disease carefully compared the marrow changes with those seen in horses dead from other diseases, and in normal horses, and they came to the conclusion that there was nothing specially characteristic in the appearance of the marrow in infectious anaemia since exactly similar appearances were to be met with in animals examined after death from a variety of other causes.

The author undertook a comparative study of normal bones and bones in various diseased conditions, his observations being made principally on the femur, humerus, and ribs. The bones were removed as soon after death as possible and if not examined at once they were placed in a refrigerator to retard post-mortem changes. Most of the bones were cut longitudinally through the middle of the shaft, cleaned of debris, and a number of coloured reproductions were made immediately. Smears were made from various portions of the marrow and stained by Giemsa's method. It was shown by these reproductions that many other diseased conditions may produce changes in the bone marrow that are almost, if not quite, identical with those found in infectious anaemia. It was even shown that the marrow may be darker in colour and more extensive in normal horses than it is

sometimes in infectious anaemia. The nearest approach to the so-called "embryonic marrow" was found in a case of septicaemia, where the marrow was jam-like in consistency. The more acute cases of infectious anaemia were found to have less red marrow than the more chronic ones. There were also found more normoblasts in the blood in cases of several weeks duration than in the very acute ones.

SCOTT (John W.). **Experimental Transmission of Swamp Fever or Infectious Anemia by Means of Insects.**—*Jl. American Vet. Med. Assoc.* 1920. Feb. Vol. 56. (New Series Vol. 9.) No. 5. pp. 448–454.

At the University of Wyoming Agricultural College and Experiment Station investigations have been carried out for some time upon the above disease chiefly in connection with methods of transmission. The author's predecessor, SWINGLE (L. D.), had made numerous attempts to transmit the disease by feeding large quantities of blood and urine, with uniformly negative results. A study of the literature, moreover, reveals the fact that the quantities stated by other investigators to be necessary for infection by feeding were also very large as compared with the quantity found to be sufficient to transmit the disease by inoculation through the skin. The current theory, first propagated by CARRÉ and VALLÉE, that natural infection occurs as the result of ingesting food or drink contaminated with urine from diseased horses, did not thus seem to be a sufficient explanation to account for the spread of the disease. Since 1913, therefore, the author decided to confine his investigations to the problem of external transmission. Reference has already been made to some of this author's work.

Cuts, scratches, and abrasions could be at once ruled out as possible avenues of infection on account of their accidental character and because they do not conform in incidence with the seasonal distribution of the disease; on similar grounds lice, scab parasites and ticks could be eliminated from the list of possible carriers. The only other possible vectors left, in Wyoming, were certain biting flies and mosquitoes. The results of the author's experiments with mosquitoes led him to believe that they did not ordinarily act as transmitting agents. On the other hand, his preliminary work with stable flies (*Stomoxys calcitrans*) indicated that they were probably responsible and from 1914 to 1916 further experiments were made which lent confirmation to this view. It appeared that the flies might well transmit the disease in nature if they were present in large numbers and the conditions were favourable for interrupted feeding.

The only species of Tabanidae available for experiment in sufficient numbers was *Tabanus septentrionalis*, Loew., and the results showed that this fly was also capable of transmitting the disease. If certain biting flies are capable of acting as vectors, then the inoculation of a very small amount of the virus ought to produce the disease. In order to demonstrate this a medium fine hypodermic needle was used to pierce the skin of an infected horse in one cage and it was then immediately used to pierce the skin of a healthy horse in another cage. This procedure was repeated with another horse. Of these two horses one developed a mild form of infectious anaemia and then apparently

recovered completely, while the other horse remained healthy. This result, the author concludes, tends to confirm the results obtained with insects. A number of suggestions are formulated for the control of the disease based upon existing knowledge.

HABERSANG. **Experimentelle Uebertragung der infektiösen Anämie der Pferde auf das Schwein.** [Experimental Transmission of Equine Infectious Anaemia to the Pig.]—*Mitteilungen aus der Berliner medizinischen Klinik. Monatshefte f. prakt. Tierheilkunde.* 1919. Vol. 30. p. 171. [Extracted in *Schweizer Arch. f. Tierheilk.* 1920. Jan. Vol. 62. No. 1. pp. 35-36.]

Bearing in mind the results obtained by the Japanese Commission for the investigation of infectious anaemia the author conducted experiments in order to ascertain whether the form of the disease occurring among horses in Germany was also transmissible to pigs, whether distinct clinical symptoms were manifested in infected pigs, and whether the blood showed any characteristic changes.

A three-months-old pig was injected with 5 c.c. of serum from an affected horse. On the 11th day its temperature rose to 40·2° C. but no other symptoms were shown and this pig developed better in condition than an uninoculated control pig which showed a temperature varying from 39·1 to 39·7° C. during this period.

On the 38th day after the inoculation some blood was taken from the pig and inoculated into a horse. Twenty-two days afterwards this horse began to show fever and a diffuse dark red discolouration of the nasal mucous membrane together with a dirty yellow colour of the conjunctiva and vaginal mucous membranes. On the 68th day it became affected with a second attack of fever and the same clinical symptoms; the body weight decreased and the red blood corpuscles suddenly became greatly diminished in numbers. The horse had undoubtedly therefore become infected with infectious anaemia. No macroscopic lesions whatever could be observed in the inoculated pig after slaughter but normoblasts appeared in numbers in the blood and the haemoglobin content sank. The author thus concludes that the pig is susceptible to infectious anaemia and may act as a carrier of the disease.

DU TOIT (P. J.). **Gastruslarven und infektiöse Anämie der Pferde.** [Bots and Equine Infectious Anaemia.]—*Monatshefte f. praktische Tierheilkunde.* 1919. Vol. 30. p. 97. [Extracted in *Schweizer Arch. f. Tierheilk.* 1920. Jan. Vol. 62. No. 1. pp. 34-35.]

After injection with the watery extract of bot larvae a horse manifests a typical reaction as shown by uneasiness, dyspnoea, accelerated pulse, irregular thumping heart action, frequent defaecation, trembling of the muscles, weakness in the hind quarters, blood changes such as increase in the red corpuscles, increase in haemoglobin content, and increase in the number of leucocytes, especially the neutrophile leucocytes, and slight haemolysis. This reaction the author regards as toxic in nature and not anaphylactic. The potent portion of the extract passes through a Berkfeld filter. The severity of the reaction depends upon the size of the dose. A certain tolerance towards

increasing doses may be exhibited, but the presence of antitoxins in the blood cannot be demonstrated. A watery extract obtained from the tapeworms of the dog produces a similar reaction.

Repeated injections with bot extracts produced a gradual intoxication as shown by loss of condition, decrease in the number of red blood corpuscles and dullness, but febrile attacks as seen in infectious anaemia were never observed. Fatal results can be produced by the inoculation into a healthy horse of blood from a horse injected with bot extracts, but infectious anaemia is not thereby transmitted. Du Toit concludes from numerous careful experiments that there exists no relationship between bots and equine infectious anaemia.

TEPPAZ. **Un nouveau cas de rage du chien au Sénégal.** [A Further Case of Canine Rabies in Senegal.]—*Bull. Soc. Path. Exot.* 1920. Jan. 14. Vol. 13. No. 1. pp. 16–18.

Although canine rabies is not altogether unknown in French Senegal and two cases have been previously recorded by the author himself, viz., in 1910 and 1911, there is a widespread belief in the Colony that rabies does not exist in it. Rabies has also been observed in French West Africa by CAZALBOU, BOUFFARD, ALDIGÉ, and HECKENROTH. In this note the author describes a case of furious rabies in a fox terrier dog, the disease being confirmed by inoculation of rabbits. One rabbit died in 17½ and the other in 15½ days (after intra-ocular and intramuscular injection).

HECKENROTH observed a nervous disease in the dog in West Africa resembling rabies [see this *Bulletin*, 1918, Vol. 6, No. 4, p. 247], and it is probable that this condition was but a mild form of rabies which had become attenuated in the native dog.

HASSELTINE (H. E.). **The Diagnosis of Rabies in Animals. A Statistical Study of the Records of the Hygienic Laboratory for the Period 1909 to 1919.**—*Public Health Rep.*, Washington. 1919. Oct. 24. Vol. 34. No. 43. pp. 2378–2388.

This study, compiled from the records of the Hygienic Laboratory, United States Public Health Services, was undertaken to determine the reliability of the microscopical examination for the presence of Negri bodies as a means of diagnosing rabies. During the above period of ten years 1,127 specimens from suspected animals of various species were received and examined by (a number) of officers of the Service ; the general method of examination, however, is said to have been practically constant throughout.

Three types of tests were used, designated as the smear, the section, and the inoculation test. Some brains were subjected to all three tests but after a time this practice was discontinued as it was deemed that when Negri bodies were found by microscopic examination the inoculation test was almost invariably positive. Inoculation was therefore only resorted to when Negri bodies could not be found under the microscope or when the presence of these bodies was doubtful.

Smear test.—A thin section of the hippocampus major (Ammon's horn) of the brain is removed and placed on a clean glass slide. The section is then crushed between two slides and the slides are drawn apart so that a uniform smear of the brain tissue is left upon each side.

The smear is flooded with methyl alcohol (ethyl alcohol may be used) for 1 minute, the alcohol is poured off and the smear stained with fuchsin-methylene blue, the preparation being steamed slightly for about 1 minute. The stain used ought to be prepared fresh daily as follows: To about 50 c.c. of distilled water add 3 drops of a saturated alcoholic solution of basic fuchsin and about 5 drops of saturated aqueous solution of methylene blue, mix well and use at once. If the smear is too red or too blue the stain may be modified by adding one or two more drops of the stain desired and repeating the staining process on another smear.

The smear is examined first under a low power of the microscope in order to locate the field showing the large pyramidal cells of the hippocampus major. This field is covered with a drop of oil and then examined with the immersion lens. The large cells should be stained blue; the Negri bodies if present are stained red and are found lying within, or near, the cells. Closer examination usually reveals small blue dots or several such dots within the Negri bodies, though at times these dots are difficult to demonstrate. Before a positive diagnosis is made it is important to find the Negri bodies actually within the cells, although the method of preparation often causes the bodies to appear outside the cells. Owing to the resemblance of the red blood cells to the extra-cellular bodies the finding of intra-cellular bodies must be taken as the basis of a positive diagnosis. If a positive result is obtained in this way no further tests need be made, but several smears taken from the hippocampus in both cerebral hemispheres should be examined before the smear method is concluded to yield negative results.

Section method.—This is a little more accurate than the smear method but it is less practicable as it involves more time and work. Brains received after having been placed in formalin or some other fixing solution could, however, be examined only by this method. Fixing in Zenker solution and staining with eosin-methylene blue was found to give the best results. Paraffin was used for embedding. The hippocampus cells then stained blue and the Negri bodies red with, usually, blue inner bodies. All the bodies should be found within the cells as the method of preparation does not break up the cells.

Animal inoculation method.—This is used in all cases in which the microscopic finding is negative. A piece of brain tissue (hippocampus, medulla, or other part) is placed in glycerine for from three to five days with the object of lessening the danger of suppuration which may result from the presence of contaminating organisms. Otherwise if the brain is not steeped in glycerine the animals frequently die during the first three days after inoculation. The glycerinised brain is then ground with sterile salt solution into a thick emulsion and a small quantity, about 0·2 c.c., injected subdurally or intra-cerebrally into guinea-pigs or rabbits. At least two animals are inoculated from each suspected case. The animals are then observed for symptoms of rabies and if they die after a period of five days an examination of their brain for Negri bodies is made. Animals should be kept under observation for at least six months although most of those developing rabies will show symptoms within two months.

Of the 1,127 brains received 124 were not examined (18 were destroyed in killing the animal, usually the result of shooting at close range with a shot gun, 7 brains were nearly completely destroyed in killing and partly decomposed, 98 brains were so far decomposed that examination was impossible and in one case the animal was brought to the laboratory alive, observed for two weeks with negative results, and then returned to the owner). Out of the remaining 1,003 cases positive results were obtained in 588 (514 in dogs, 34 in cats, 32 in cattle, 1 in horses, 5 in pigs, 1 in sheep, and 1 in man).

The author gives statistics to indicate the seasonal prevalence of rabies. The following table which summarises the occurrence of

Month.	Positive	Negative	Not examined	Monthly average positive	Percentage positive of those examined
March	75	35	6	6·87	68·2
January	65	26	5	5·90	72·0
December ..	55	20	4	5·50	73·3
February	61	36	2	5·56	62·1
November ..	54	26	3	5·40	67·5
April	52	48	9	4·73	52·0
May	46	47	11	4·60	49·5
June	39	46	12	3·90	46·4
October	38	22	6	3·80	63·3
July	37	49	25	3·70	43·0
September ..	36	23	17	3·60	61·0
August	30	37	24	3·00	44·8
Total ..	588	415	124	—	—

rabies by months during the years 1909–1919 demonstrates that the greater number of positive brains were obtained in the colder months, which is directly opposed to the popular belief that rabies is more prevalent in the hot months. The lower prevalence in summer indicated by these statistics may be attributable to this popular belief that dogs become rabid only in warm weather. As a result of this belief if any dog appears sick or abnormal in warm weather the animal is promptly killed and the head sent in for examination. Consequently in warm weather some dogs that are not rabid are killed and submitted for examination. On the other hand, in cold weather the animal is not regarded with as great suspicion and animals that are not rabid are kept until they recover, while those suffering from rabies die of the disease and the brains are then forwarded for examination. Moreover, many specimens were in such a state of decomposition that they could not be examined during the warm weather.

Many specimens were in a bad condition when received, but one or more tests were made on them and the results are embodied in the figures of this report. General decomposition or softening of the brain tissues makes it impossible to obtain sections and it may cause premature death of inoculated animals. But, it is often possible to obtain smear preparations from the hippocampus major of what

seems to be a hopelessly decomposed brain. The hippocampus seems to be one of the last parts of the brain to break down.

Results obtained from different types of tests.—389 specimens were submitted to the animal inoculation test in addition to the microscopic tests; 29 of these (7·5 per cent.) were found positive by the inoculation test but negative by the microscope. Also, out of 410 specimens 36 were found negative on examination by the smear method but later found positive in sections or by the inoculation test, making the error of the smear method 8·8 per cent. These examinations were distributed among 11 different workers who had charge of the work at various times and the number charged against each man was in proportion to the length of time he was assigned to the work.

The author's figures also show that in five cases (1·3 per cent.) a positive finding was reported on microscopic examination and failure of confirmation by animal inoculation, making the total error of the microscopic test 8·7 per cent. The cases which were reported as positive and which failed to show rabies in the inoculated animals are attributed in part to an effort to avoid reporting a specimen "doubtful" or "suspicious." In some of these cases the records show that there was doubt but that the examiner deemed the microscopic evidence to indicate the presence of Negri bodies. The five specimens thus reported were distributed among four different workers and each error was made in the early part of each man's service, showing the conservative tendency of a new man to consider doubtful cases as positive.

The percentage of error given above is based on the assumption that the animal inoculation test gives 100 per cent. of positive results. This, probably, is not always true, and the author quotes a case in point in which two guinea-pigs were inoculated from a suspected cat's brain which gave a negative result to the microscopic test. One guinea-pig died 31 days later, and Negri bodies were found in its brain, while the other guinea-pig was kept under observation for nine months subsequently and showed no symptoms. If the first guinea-pig had died within five days of inoculation from extraneous causes the original specimen would have been considered negative. However, such occurrences are held to be negligible and probably due to error of technique in inoculating one of the animals.

488 specimens were reported positive and 88 reported negative on the result of the microscopic test only. While it is admitted that the diagnosis might have been erroneous for the 88 negative cases, many of which were not submitted to animal tests on account of the extremely poor condition of the specimen, it is considered hardly possible that there might have been any mistake in the 488 positive specimens, the latter constituting the easily diagnosed and undoubted cases showing Negri bodies, and if doubt had existed it is stated that they would have been submitted to the animal inoculation test and consequently would have been tabulated as specimens submitted to two or three tests.

The time required for the performance of the different tests is said to be approximately as follows: Smear test; 1 hour (frequently less) after arrival of specimen. Section test: Three to four days (a hurried test can be done in a day but will usually be unsatisfactory). Animal inoculation test: Ten days to six months. After 30 days the probability of a positive result is small.

The author therefore concludes that the correct diagnosis may be obtained on the day of receipt of specimen in 90 per cent. of cases; within five days in about 92 per cent.; and, at the end of one month practically all will be determined. Hence a negative report on microscopic examination with subsequent inoculation of animals practically becomes a confirmed negative at the end of one month, though it is the rule at present to observe animals for six months.

CROVERI (Paolo). **Esperimenti di vaccinazione contro la peste bovina con il metodo della siero-infezione di Schein.** [Experiments upon Vaccination against Rinderpest by means of Schein's method.]—*Bull. Soc. Path. Exot.* 1919. Oct. Vol. 12. No. 8. pp. 487-489.

SCHEIN published in 1917 the results of a number of experiments carried out in French Indo-China upon the method of vaccination against rinderpest by the simultaneous inoculation of serum and virulent blood; the quantity of infective blood injected was so small as to approximate the minimum virulent dose, that is 1-1,000th c.c. and it was hoped in this way to produce as slight a reaction as possible. A trial of this method in the field appeared to give a very satisfactory result. [But, on the other hand, it is difficult to see how this variation of KOLLE and TURNER'S original method represented an actual improvement inasmuch as SCHEIN'S own experiments appeared to indicate that the minimum infective dose was capable of setting up as severe a form of the disease as that produced by very much larger doses (this *Bulletin*, 1918. Vol. 6. No. 1. p. 32).—ED.]

In preparing virulent blood for injection SCHEIN added 1 c.c. of blood drawn from an infected animal to 1 litre of water that had been boiled, containing in solution 8 grammes of sodium chloride and 2 grammes of sodium oxalate. This remained active for about 12 hours.

In Italian Somaliland the author states that KOLLE and TURNER'S original method has always given very good results. But, as no doubt it would be of great advantage to substitute for it the method recommended by SCHEIN if it proved equally effectual, the author carried out some experiments on its practical application. Four susceptible calves of about 15 months old each were vaccinated with 25 c.c. of anti-rinderpest serum simultaneously with 1 c.c. of the 1-1,000 dilution of blood taken from an experimentally infected calf on the 5th day after first showing symptoms. The calves weighed about 120 kilogrammes each. They were kept under observation for two months and showed no symptoms whatever. However, about three months after the vaccination these calves were inoculated according to the usual, KOLLE and TURNER, method and each subsequently gave a typical reaction, which would prove that inoculation with very small doses of virulent blood as recommended by SCHEIN is not capable of setting up with certainty an active immunity in Italian Somaliland.

CROVERI (Paolo). **Prime constatazioni di peste equina in Somalia.** [The Discovery of Horse Sickness in Italian Somaliland.]—*Bull. Soc. Path. Exot.* 1919. Oct. Vol. 12. No. 8. pp. 485-487.

South African horse sickness is known to exist in British East Africa and in Eritrea and it is possible that a particular disease known as

"climatic typhus" among horses during the Italian occupation of Somaliland was also, in reality, horse sickness. It has also been observed in Abyssinia and very likely the cases examined by the author in Somaliland were infected with virus from this source. Towards the end of April 1917 there occurred in Bulo-burti, an outpost on the border, situated on the Webi-Shebeli River towards Abyssinia, a severe outbreak of disease among mules. This rapidly spread to the animals in the surrounding districts. At first anthrax was suspected as this had appeared among camels which had arrived from the interior of the country. This disease was, however, excluded by microscopic examination and the symptoms pointed strongly to horse sickness. The presence of the disease in a mule at Mogadiscio which had been brought in from the interior was further, it would appear, verified by clinical and experimental diagnosis. The form of the disease that appeared to be most prevalent was the more rapidly fatal variety, or the dunkop form.

MOREL. **Etude anatomo-pathologique des lésions de la langue dans la flèvre aphteuse chez les bovins.** [The Nature of the Tongue Lesions in Foot-and-mouth Disease in Cattle.]—*Bull. Soc. Cent. Méd. Vét.* 1920. Mar. 4. *Rev. Méd. Vét.*. 1920. Feb. 29–Mar. 30. Vol. 96. Nos. 4–6. pp. 94–109. With 4 text-figs.

The author was able to obtain facilities for the systematic histological examination of the very early lesions on the tongue in foot-and-mouth disease at the slaughterhouses at La Villette, Paris. The amount of work done on this subject appears to have been somewhat limited. The first description appears to be that of PERNICE and REGGIO (1911), while KALLERT, E (1914) published a series of important researches upon the histogenesis of the vesicle in foot-and-mouth disease. [This *Bulletin*, 1917. Vol. 5. No. 1. p. 47.]

The author's histological studies, which were made on material obtained from 80 subjects, may be briefly summarised as follows:— The morbid process takes place actually within the Malpighian layer (or rete mucosum) of the epidermis, and it attains its maximum degree of intensity at the level of the middle layer of the epidermis. It commences in the dermis and is manifested by a reaction in the blood and lymphatic vessels and connective tissue cells in the papillae. The leucocytes wander out of the vessels by diapedesis and invade the epidermis after traversing the basal layer.

The prickle cells of the Malpighian layer of the epidermis then undergo a particular kind of change commencing in the lower and middle part of this layer. A few cells lying adjacent to the basal layer undergo a kerato-hyaline degeneration, become necrotic and take on a deep acidophile staining with pyknosis of the nucleus.

As the lesion progresses minute necrotic islets are formed which soon become surrounded with a serous fluid containing polynuclear and eosinophile leucocytes. Around these minute abscesses the cells, which are compressed and dissociated, degenerate rapidly and become vacuolated and affected with chromatolysis of their nuclei. They then become rounded in shape and lose their prickles. Each necrotic islet

becomes increased in height and breadth and amalgamates with other adjacent minute abscesses. This fusion results in the formation of an enormous vesico-pustule or aphtha, the uppermost boundary of which soon becomes the stratum corneum (or horny layer of the skin).

The aphthous lesion is therefore composed of masses or blocks of necrotic cells and it is infiltrated with a serous exudate filled with polynuclear leucocytes and partitioned off into compartments by trabeculae composed of the basal cells which surround the papillary spaces. The floor of the lesion is also composed of more or less disintegrated basal cells. The median trabeculae very rapidly become destroyed and one may observe various alterations in the cells surrounding the bleb, particularly a vacuolisation of the sub-corneal cells which become invaded by the fluid exudate. The dermis at this stage is infiltrated with leucocytes and embryonic connective tissue cells while the vessels in it are congested.

The corneal layer (stratum corneum), which has become distended by the fluid exudate, becomes ruptured on account of the movements of the tongue and the passage of food. After the escape of liquid there remains a superficial ulcer, the base of which is composed of necrosed cells embedded in a fibrinous network. Inasmuch as the subcorneal layer and epidermis has become infiltrated and changed the tongue may be denuded over a large surface.

Cicatrisation is rapidly brought about. The Malpighian epithelium is regenerated through the agency of the basal cells which remain intact and multiply rapidly. The young cells thus produced develop rapidly into corneified cells and establish a protective barrier between the new epidermis and the superficial disintegrating clot which gradually becomes forced upwards and eliminated piece by piece.

The author compares the nature of the foot-and-mouth disease bleb with that found in some other diseases. In foot-and-mouth disease the changes are of an acute and quickly-occurring necrotic character, manifested by the production of a minute central sequestrum with degenerated oedematous cells at its periphery. These phenomena do not appear to have been hitherto described, it appears, at any rate in connection with the essential, primary, lesions, and the histological changes which take place in variola, eczema, zona (herpes zoster), prurigo, and Duhring's polymorphic dermatitis appear to be of an entirely different order.

MISCELLANEOUS.

MAGALHÃES (Octavio). **Peste dos Polmões (1ª Nota Previa).** [Abscess Plague (a Brazilian Disease of Cattle). Preliminary Note.]—*Brazil Medico.* 1920. Feb. 21. Vol. 34. No. 8. p. 123.

In this preliminary note the author states that he has been investigating this disease of cattle for a number of years. The condition manifests itself as a cutaneous affection which assumes an enzootic distribution and affects preferably cattle without exhibiting any predilection as regards age, breed, or locality, but it has also been identified among goats.

Two forms are recognised, viz., an acute form which may end fatally within 48 hours (in the natural or experimental disease), and a chronic form which may take from 20 to 30 or more days before death supervenes. The chronic form, associated with the development of abscesses, may change into an acute form, without abscesses.

A dominant symptom exhibited in the chronic form is diarrhoea, especially in young cattle, and this would indicate that the causal agent shows a preference for the intestine. The chronic form, of the natural or experimental disease, may manifest itself as an intestinal affection. Chronic cases may also be seen in which one or more abscesses develop but subsequently disappear, and in their place the only symptom often seen is emaciation, and the animals thus succumb from cachexia ; this form might be ascribed to an intoxication.

It is possible to reproduce the disease, with typical symptoms, by inoculating susceptible animals with filtrates obtained by passing pus or blood through a Berkfeld filter. In the abscesses bacilli of the Vryburg type were encountered together with numerous other organisms in varying numbers. It was established experimentally that the disease was tick-transmitted. The filtrate obtained after passing an emulsion made by triturating the tick in normal saline solution through a Berkfeld filter was capable of setting up the typical disease in bullocks after inoculation. Larvae obtained from infected ticks were not capable of setting up the disease.

The mortality rate varied ; in certain instances it attained 100 per cent. of the cases. The morbid anatomy and clinical symptoms of the disease are to be described later.

[Reference to this disease has already been made in this *Bulletin* (1918, Vol. 6, No. 1, p. 18) : Palazzola described the disease and attributed it to infection with small bipolar organisms of the Pasteurella group.—Ed.]

REPORTS.

India. **Report on the Progress of Agriculture in India for 1918–1919.** [Progress in Veterinary Work.—Chapter 6. pp. 119–143. With 2 plates & 2 tables (Also Appendices iv–v. pp. 169–170).—1920. Calcutta. Superintendent Govt. Ptg., India. [Price Rs. 1–4 or 2*s.*]

In this publication a summary is given of the work done by the various provincial Civil Veterinary Departments in India and the Imperial Bacteriological Laboratory at Muktesar.

The following subjects are dealt with : (1) Administrative changes and incidence of cattle disease ; (2) preventive inoculation and legislation ; (3) cattle breeding ; (4) sheep breeding ; (5) veterinary education ; and, (6) veterinary research. Horse breeding operations were carried out on a small scale in some districts under the control of the Army Remount Department. Considerable progress is reported to have been made in several Provinces in spite of the great inadequacy of the present organisation of the Department to cope with the work demanded of it. This shortage has been referred to in a preceding number of this *Bulletin* in an abstract of the Proceedings of a Meeting of Civil

Veterinary Officers held at Lahore in March 1919 [1919, Vol. 7, No. 4, p. 262]. The Surra Committee met twice during the year and arrangements were made for the provision of suitable stables on dak routes. Experiments upon the value of fly repellents and on the efficacy of drug treatment for surra were continued. The Government of India have under consideration the making of a fly survey, the improvement of the existing arrangements for reporting cases of all kinds of contagious animal diseases, and the extension of the Glanders and Farcy Act so as to include camels.

The first section of this report contains much detail regarding the personnel of the Department and the dispensaries and hospitals in the various Provinces. The following are the points noted with regard to the incidence of stock disease—

In Bombay the total mortality from contagious diseases during the year was 10,550, as against 21,137 in 1917–1918. There was a marked decrease in the mortality from rinderpest and haemorrhagic septicaemia, which is attributed to the scanty rainfall. Among equines there were 149 deaths from surra, as against 230 in the preceding year. The Department in this Province was placed during the year under the direct control of the Local Government, and the Director of Agriculture is therefore no longer responsible for its administration.

In Madras there was a considerable decrease in the number of deaths from anthrax, haemorrhagic septicaemia and blackquarter, but the continued increase in the number of deaths from rinderpest more than counterbalanced this decrease, and the total mortality from contagious diseases, viz., 76,114, exceeded that of the previous year by over 6,000. About 4,919 cattle and 2,413 sheep and goats were passed from the Cattle Quarantine Depot, Tuticorin, for shipment to Colombo, as against 4,952 cattle and 67,664 sheep and goats passed last year. The Madras Cattle Diseases Act which was in force in the Nilgiris throughout the year enabled the Department to stamp out successfully several outbreaks of rinderpest in this part in a very short time; equally successful results were obtained during an outbreak of the disease at Kodaikanal. A severe outbreak, however, occurred involving the loss of most of the valuable Australian and half-bred cattle at the Coimbatore Agricultural Farm in the early part of the year and carried off 55 animals. It has since been decided that Government cattle on Agricultural Farms, Jails, etc., shall in future be inoculated by the "serum simultaneous" method to make them immune against the ravages of rinderpest.

In Bengal there was a considerable decrease in the number of deaths from contagious diseases, the total mortality being 15,569, as against 26,486 in the preceding year. This decrease was most striking in the case of rinderpest, the recorded number of deaths being 10,772, as against 21,126 in the previous year.

In Bihar and Orissa there was a decrease in the number of outbreaks of contagious diseases and on the whole the year was considered a healthy one in most districts. Considerable difficulties were experienced in carrying out inoculations in some of the Districts, especially Ranchi. The Superintendent [QUINLAN, D.] complains that the time of District Officers is now taken up with other duties so that it is almost impossible for them to pay any attention

to inoculation work, and unless the numbers engaged on the staff of the Department are increased all round very little can be done to combat preventable diseases.

In the United Provinces the reported mortality from contagious diseases was 16,233, as against 17,407 in the preceding year. Rinderpest, as usual, was the most serious disease and accounted for 11,821 deaths. There was a considerable fall in the death rates from haemorrhagic septicaemia, anthrax, blackquarter, foot-and-mouth disease, and surra. The functions of the Department in so far as horse breeding was concerned were confined to the improvement of the indigenous horse and pony for general utility purposes in tracts other than the selected districts of Aligarh, Muzaffarnagar, Bulandshahr, and Meerut. The tracts are said to be now producing a very good type of animal, which may be expected to show still further improvement.

In the Punjab contagious cattle diseases accounted for 28,794 deaths, as against 30,325 in the preceding year. Over 70 per cent. of the mortality was attributed to rinderpest, which was prevalent throughout the Province and was aggravated by the scarcity of fodder. Surra accounted for only 70 deaths as against 1,362 in the previous year. The mortality due to other diseases was also below the normal, probably, it is stated, owing to the dry character of the year.

In Burma a severe outbreak of rinderpest in several Lower Burma Districts and in Katha in Upper Burma accounted for about 25,000 out of the 30,451 deaths from contagious diseases reported during the year. Inoculation was practised extensively in checking the disease; 64,824 injections were made as compared with 12,807 in the previous year. A number of very good rules have been framed for the prevention of contagious diseases and in some Districts the rules are well observed, but their evasion by a few cattle owners largely nullifies the beneficial effects that ought to be derived from them. The offenders are included for the most part among the cattle owners in the neighbourhood of Rangoon and other towns, in which large herds are kept for the sale of milk. This matter has been recently investigated by the Stockbreeding Committee, whose recommendations are under the consideration of the Local Government.

In the Central Provinces the number of deaths from contagious disease was 21,344, as against 24,380 in the previous year. Rinderpest was very prevalent but it occurred in a mild form in most of the districts; inoculation proved quite effective and reduced the mortality to 0·024 per cent. Anthrax existed in a sporadic form but did not cause much damage. The number of cases of surra reported was 264, as against 542 in the previous year. A dog was found to be suffering from surra at Seoni and one has thus to bear in mind the possibility of dogs being infected in tracing the origin of outbreaks. The Superintendent [WILSON, C. W.] reports that "in the course of an investigation of surra in Khurai tahsil it has been well established that bovines succumb to surra alone and that surra parasites are seldom detected in the blood after death of typical subjects." A disease resembling feline typhus again appeared in two Districts.

In Assam there was a general decrease in the mortality from contagious diseases and it was especially low amongst bovines. Out of the total mortality of 20,819, as against 47,932 of the preceding

year, rinderpest accounted for 7,239, as against 29,808, and anthrax for 1,190, as against 2,748, during 1917–1918. There were 10 deaths from surra, as against 13 in the previous year. An outbreak of surra among Government mules in the Manipur State was prevented from spreading by the destruction of the infected animals. Considerable difficulties were experienced in finding suitable assistants for the work of the Department on account of the niggardly pay and prospects of the service.

In the North West Frontier Province 31,293 cases of contagious diseases were reported, of which 7,224 proved fatal, as compared with 25,247 cases and 2,904 deaths in the preceding year. 66 cases of surra occurred. Rinderpest accounted for a large percentage of the mortality amongst the bovines, but a good deal of progress has been made in inoculation work and it is stated that the natives now readily bring forward their animals for inoculation when the disease is prevalent.

In Sind, Baluchistan, and Rajputana, which were all under the control of one Superintendent progress was impeded by the great shortage in staff. In Sind the total mortality from contagious diseases was 4,125 as against 6,686, but these figures, however, are stated to be not quite reliable. Surra among equines was responsible for only 44 deaths, as against 258 in the preceding year; 29 camels succumbed to this disease in Karachi and four other districts. The figures, however, are not considered to give any reliable indication of the extent to which the disease was prevalent among these animals. In a microscopic examination of the blood of about 1,500 camels showing no symptoms of surra 1 per cent. was found to be affected with the disease. Foot-and-mouth disease was very widespread and carried off 387 animals out of 12,714 attacked. In Baluchistan the total mortality from contagious disease was 6,442, as against 9,286 in the previous year, and they were most prevalent amongst sheep and goats. In Ajmer-Merwara the mortality from contagious diseases was reported as 128, against 112 in the previous year.

Imperial Bacteriological Laboratory, Muktesar. [SHEATHER, A. L., Director and First Bacteriologist.]—The Second Bacteriologist [SHILSTON A. W.] succumbed to "an attack of acute glanders on the 6th July 1919"; a number of valuable contributions by this worker has been noticed in this *Bulletin*. In spite of difficulties connected with the electric centrifuges, scarcity of labour, etc., the output of the products of the Laboratory increased from 2,698,711 doses in the preceding year to 3,750,396 doses in the year under review. The branch laboratory at Kurgana (Bareilly) was opened during the winter months for the preparation of anti-rinderpest serum and to maintain rinderpest virus for use in the inoculation of animals at the various Military Dairies. The necessity of getting the new laboratory buildings at Izatnagar completed as early as possible is mentioned; otherwise it is feared it will be impossible to meet the increasing demand for anti-rinderpest serum. The number of doses issued during the year was as follows:—Rinderpest serum 3,259,616, anthrax serum 36,552, haemorrhagic septicaemia serum 132,046, haemorrhagic septicaemia vaccine 125,355, blackquarter vaccine 19,176, and mallein 160,091 doses. The total value of the different products calculated on the

value fixed by the Government amounted to Rs.4,80,732-13-9, against an expenditure of Rs.4,37,712-13-4.

Preventive inoculation legislation. In India owing to the ignorance of owners and defective reporting of outbreaks it is very often impossible to carry out preventive inoculation in time. There is hardly any restriction on the movement of cattle out of infected areas and no legislation to enforce compulsory inoculation. Moreover, the supervising as well as the subordinate staffs of the Department are quite inadequate. In spite of these difficulties satisfactory results are claimed to have been obtained during the year under review, as are gathered from the figures in the following table :—

Disease	Number of outbreaks in which inoculation was undertaken	Deaths uninoculated	Inoculations made	Deaths after inoculation	Percentage of deaths in inoculated animals
Rinderpest ..	4,794	75,186	619,199	2,641	0·42
Haemorrhagic Septicaemia	594	3,306	116,960	83	0·07
Anthrax ..	94	1,687	13,684	14	0·09
Blackquarter .	190	178	16,440	15	0·09

[The figures as displayed in this Table, however, do not convey to the mind of the reader the beneficial results following upon inoculation in their most convincing form. It is not clear whether " deaths uninoculated " refers to the mortality occurring prior to the commencement of inoculation or mortality among control animals left untreated during the progress of the operations, or to both. If they refer only to the first mentioned category then it would be reasonable to expect that the mortality rate would have diminished notwithstanding the inoculations. But, if the relative percentage mortality occurring among uninoculated and inoculated cattle after having commenced treatment had been clearly expressed one would have been better able to judge the results.—ED.]

The " serum-alone " method of inoculation is now generally adopted throughout India on account of its simplicity and safety. The method, however, has several limitations. The injections have to be repeated several times during the course of an outbreak as a single injection only affords protection for a short period of time. When employed as an accessory to strict quarantine measures the method is capable of furnishing highly satisfactory results, but in India where such measures cannot be enforced it is admittedly not effective enough for stamping out the disease. The " serum simultaneous " method, comprising the injection of virulent blood simultaneously with the serum, gives a permanent immunity to the animal and has given, it is stated, excellent results in military dairies and in the herd of cattle at the Agricultural Research Institute, Pusa. During the winter 1918–1919 40 pure bred imported animals were treated by this method and six of them died, but the deaths were not directly attributable to rinderpest ; 438 cross breds were inoculated, with six deaths ; 382

buffaloes, with one death, and 649 country animals, with no deaths. This represents a total percentage mortality of 0·86, or, excluding the pure bred imported stock, of only 0·47. It is asserted, however, that this method requires closer expert supervision and cannot therefore be adopted more generally until an adequate and sufficiently trained staff is available.

The vaccine and serum treatment against haemorrhagic septicaemia when used in good time as a preventative measure has been found to be very valuable, and cattle owners display an eagerness to pay the charges for the inoculation.

Anthrax is not easily diagnosed by laymen, and at the beginning of an outbreak it is often wrongly reported. Owing to its sudden onset and rapidly fatal termination veterinary assistants are rarely able to reach the centres of infection in time to be of much assistance. When adopted in time prophylactic measures are said to yield very satisfactory results, as they also do in blackquarter.

According to Colonel FARMER (Superintendent, Punjab) experience shows that where inoculations have been judiciously carried out very beneficial results have been obtained, but he believes that much serum is used with a minimum of advantage. Hitherto a large quantity of inoculation products have been utilised mainly to enlighten the natives upon the advantages to be obtained following upon their use. The time has arrived, however, when economic considerations must be taken primarily into account and facilities should therefore be extended to the Department to enable it to take action at the seat of an outbreak immediately after the first appearance of the disease. The staff should be sufficient to allow of careful observation of results so that the action may be continued and extended whenever necessary.

The only legal powers now possessed by the Civil Veterinary Department are contained in the Dourine Act, the Glanders and Farcy Act, and the Livestock Importation Act, supplemented in Madras by a Cattle Diseases Act. In Burma the diseases of cattle are dealt with under the Villages Act.

The Cattle Diseases Act has proved valuable in Madras in dealing with cattle disease at fairs and elsewhere. The Local Government have made a Bye-law under Section 18 of the Act under which District Magistrates are empowered to close temporarily all cattle markets and fairs, public or private, held in an area in which the Act is in force whenever they consider such a course necessary to prevent the spread of a contagious disease. The beneficial results that might result from the operation of the Act, however, are largely frustrated by the owners themselves, who often continue to hold the fairs in adjoining villages. The Government of Madras has under consideration a proposal to make municipalities responsible for reporting to the Veterinary Department the occurrence of contagious diseases within their jurisdiction by adding a Bye-law to the Municipalities Act. It is suggested that other Local Governments and Administrations might also see their way to considering the advisability of introducing similar measures in their Provinces. A slight amendment to the Dourine Act is under the consideration of the Government of India.

Although for general administrative reasons it is not yet thought advisable to seek legal powers to compel inoculation, some form of

general legislation is necessary to deal with cattle diseases, and especially to enforce segregation and limit the movements of cattle in infected areas.

Cattle breeding. The care and improvement of cattle are of first importance in the agricultural economy of India. Although there may be some good breeds of cattle in the country the valuable characteristics of these animals are being rapidly lost through indiscriminate and careless methods of breeding. Owing to the breaking up of the grazing areas and scarcity of fodder, owners of cattle have become induced to dispose of their best stock, for which there is a heavy demand from other parts of India and from foreign countries. Some of the good breeds of cattle in India are thus in danger of becoming extinct. The number of cattle of the Dhanni, Hariana, and Sahiwal breeds is no longer sufficient to meet all the demands from Bengal and the United Provinces and from abroad. The demand for Dhanni bulls in the North Punjab has been very great and with a view to protecting the breed the Local Government has lately given effect to a scheme for subsidising selected owners of this breed in Attock and Jhelum. One possible solution of the difficulty would be for the Government to maintain pure bred herds of reliable types.

The poor quality of the ordinary cattle of India is well known and is due to climatic conditions largely, to the ignorance and apathy peculiar to indigenous cattle breeding, neglect, starvation, in-breeding, and the antipathy of the natives towards the castration of bulls.

The first point to be ascertained is whether these cattle can be improved by a process of rigid selection of the indigenous cattle, or by crossing with exotic Indian breeds such as the Montgomery breed. When imported bulls are used it is urged that the breeding operations should be carried out under strict supervision, and the cross-bred animals should be protected by the "serum-simultaneous" method against rinderpest, as this disease after passage through a highly susceptible animal is capable of attaining a much higher degree of virulence. Except in special cases where rapid milk production is required and where efficient control is established the general importation of exotic breeds of cattle should be avoided on this account and the main policy of the Department should be directed towards the improvement of the indigenous breeds by selection.

The areas available for grazing purposes have been considerably reduced owing to the rapid extension of arable cultivation and a stricter conservation of jungles as reserves. It has therefore become more necessary to pay attention to the systematic cultivation of fodder crops. During 1918–1919 there was a scarcity of fodder throughout India and it was responsible for the loss of a large number of cattle. In some tracts such as in the Ahmednagor District in the Bombay Presidency the Government had even to open central camps for feeding cattle upon cactus. The animals were kept in these camps for about a month and when they had become accustomed to the diet they were returned to their owners, who were given every facility and encouragement to continue using the fodder. Such conditions do not afford much encouragement to cattle breeding and this industry must in the first place be safeguarded by taking measures to ensure a better and surer provision of cattle fodder. Cattle should therefore be bred

on cultivated lands and suitable crops must be raised and stored to meet famine conditions. These measures will, however, only be adopted by farmers when they become convinced that it is economically sound to breed and rear cattle.

The best solution of the economic problem appears to lie in the fostering of cattle breeding for a dual purpose, viz., dairying and draught, as such cattle now fetch high prices in India ; there is also a growing demand for Indian cattle in foreign countries. The price of all dairy products is abnormally high, and the cultivator needs for himself stronger cattle.

The scheme for the investigation of cattle breeding and of the dairying industry in India as recommended by the Board of Agriculture, India, in 1916 has recently been sanctioned by the Secretary of State for India. This scheme involved an initial cost of Rs. 2,22,000 and a net recurring expenditure of Rs. 1,68,446 per annum. The scheme provides for an organisation which, working on the material provided by the Military Dairy Farms, will undertake breeding operations designed to improve the milking qualities of Indian cattle and will at the same time commence systematic education in dairying by opening dairy schools. The whole question of cattle breeding including animal nutrition problems is thus now to receive attention from an Imperial point of view. The scheme, however, is not intended to limit Provincial activity but has as its object the encouragement of local effort in this direction.

The report then goes on to review at length the cattle breeding operations under the control of the Department in the various Provinces and at the Agricultural Research Institute, Pusa.

Sheep breeding. In India sheep breeding cannot be carried out advantageously except in certain favoured localities as the climatic conditions are such that the quality of the fleece and the mutton cannot be improved conjointly. This has been proved conclusively, it is stated, by experiments carefully carried out at Pusa for the last 15 years. The experiments carried on in the United Provinces, the Punjab, and the North Western Frontier Province have yielded encouraging results in so far as wool production is concerned. The task of teaching the poor conservative Indian shepherd the proper handling of sheep and wool, the method of shearing, dipping, etc., is by no means an easy one. If these experiments ultimately demonstrate that the quality and quantity of Indian wool can be permanently improved the question will be worth more serious consideration from the commercial standpoint. The efforts of the Department in the various Provinces in this direction are detailed.

Veterinary Education. The Veterinary Colleges at Bombay, Madras, and Calcutta continue to give a three year course in English while at the Lahore College a four year course was held in addition to a three year course. These courses are taught in the vernacular. There was no post-graduate course at the Lahore College during the year but the re-opening of this course was contemplated in November 1919. The total number of students passing the final examinations of these Colleges was 142. In Burma the Veterinary School at Insein, which gives a three year vernacular course, turned out 12 students and the School at Taungyi which gives a 1½ year course passed two trained

students. There was increasing difficulty in obtaining suitable candidates for admission to these Colleges and in Madras candidates had to be induced to enter by increasing the monthly stipends from Rs.10 to Rs.15. The hope is entertained, however, that the improvement in the pay and prospects of the subordinate veterinary staff, which some of the Local Governments have under consideration, will result in a large number of better qualified candidates seeking admission to these Colleges and Schools.

The demand for veterinary graduates for employment in the various Provincial Departments, the Army, and the Indian States continued to increase and this demand is not likely to be satisfied until another veterinary college is opened in Northern India. The teaching staff of the existing Colleges requires strengthening by the addition of more European teachers, and in order to obtain uniformity of teaching it is suggested that the curricula at the schools should be brought into conformity with those adopted in British schools. The recommendations of the Lahore Conference of 1919 in this respect have already been noticed in this *Bulletin* [*loc. cit.*]. Veterinary Associations have been instituted in the United Provinces and the Punjab.

Veterinary Research. Owing to the shortage of staff not much time was devoted to this work, but some experiments were carried out at Muktesar on the following subjects.

Rinderpest and haemorrhagic septicaemia.—Experiments undertaken in order to determine the length of time during which hides removed from animals that had died of these diseases remained infective were continued under varying atmospheric conditions.

Surra.—Experiments were continued at Muktesar. Several members of the Department obtained promising results, on a limited scale, in the treatment of the disease. Those obtained by BRAMFORD at the Government Cattle Farm, Hissar, were considered to be particularly encouraging.

A considerable amount of work was done by the Imperial Pathological Entomologist on the prevention of surra transmission by Tabanidae particularly among transport camels. It is said, however, that further experiments in this direction are necessary before definite conclusions can be drawn.

Johne's disease.—This was identified in material obtained from two animals at Bettiah (Bihar). Further attempts were made to cultivate the organism.

Tuberculosis.—A number of strains of tubercle bacilli are being cultivated at Muktesar and a series of inoculation experiments with cattle and buffaloes are contemplated.

Parasitic worms.—A new species of worm causing fatal gastritis in calves was detected by SHEATHER [this *Bulletin*, Vol. 7, No. 4, p. 203]. Another parasitic worm occurring in the larynx and pharynx of cattle and buffaloes was described [this *Bulletin*, this No., p. 133].

Malaria.—What appears to be a true malarial infection in a buffalo was discovered and described by SHEATHER [this *Bulletin*, Vol. 8, No. 1. p. 14].

Vaccines for the treatment of distemper and pneumonia were being investigated at the Research Station at Badshahbag, United Provinces. A series of experiments to determine the most economical and effective

form of drug treatment for the numerous internal and external parasites of sheep and cattle was also undertaken at this Station.

The meeting of Veterinary Officers held at Lahore in March 1919 pointed out the immediate necessity of establishing a properly equipped and staffed central research institute for animal diseases. This question is under the consideration of the Government of India.

BRITISH GUIANA. **Report of the Department of Science and Agriculture for the year 1917.**—Veterinary Division. [MILNE (A. Seton) Government Veterinary Surgeon] pp. 67–68 f'cap. 1919. Georgetown, Demerara: "The Argosy" Company.

This report contains very little information, chiefly, it appears, on account of the fact that contagious disease has been almost entirely stamped out of the Colony. The only outbreak was a small one of anthrax in a herd that had not been vaccinated during the preceding year. There were no cases of swine fever, and no cases of glanders have occurred for three years, of cerebro-spinal meningitis for five years, of contagious pleuro-pneumonia for 2½ years. A few years ago, it is stated, these diseases were playing havoc with the stock of the Colony.

CEYLON. **Administration Reports for 1918.**—Report of the Chief Veterinary Surgeon [STURGESS, (G. W.).] pp. 6 f'cap.

There was a marked decrease in the incidence of rinderpest during the year (total number of cases 161 against 2,076 in the preceding year). Outbreaks occurred in three Provinces and six remained free.

Foot-and-mouth disease was very prevalent throughout the year and all the Provinces except the Southern Province were affected (total number of cases 10,377 against 7,132 last year). As usual the disease was of a very mild type and spread with great rapidity.

Only 24 cases of anthrax were reported in the Provinces and three cases in Colombo Town. At the Quarantine Station there were 1,302 cases amongst goats and sheep imported from Southern India. There were 44 confirmed cases of rabies and 221 persons underwent treatment at the Pasteur Institute at Colombo and Coonoor.

Thirty cases of "swine septicaemia" were reported, all from the Western Province. There were 23 reported cases of blackquarter in the Southern Province and seven cases in Uva. No cases of piroplasmosis or of surra were observed.

Fifteen cases of ophthalmia occurred amongst cattle in the Central Province but all recovered under treatment.

With the exception of one case of anthrax there was no contagious disease noted among horses during the year. The total number of cattle and buffaloes for the whole Island was 1,582,060. 78 horses, 5,218 cattle, 9,607 sheep and 56,680 goats were imported during the year, but compared with the figures for 1914 there has been a considerable decrease in importation. However, there has been no distressing shortage of meat in the Island. 54,896 cattle, 12,091 buffaloes, and 96,531 sheep and goats were slaughtered for food during the year.

Details are given with regard to the working of the Government Stock Farms.

GOVERNMENT OF THE GOLD COAST. **Report of the Veterinary Department for the Year 1918.**—[O'DEA (M.E.) Acting Veterinary Officer.]—5 pp. f'cap. 1919. Accra: Govt. Press.

The veterinary work of this Colony appears to have been carried out by an unqualified staff under the direction of a Medical Officer. As in former years all cattle arriving at Coomassie from the Northern Territories and French Dominions were inspected before they were slaughtered or allowed to proceed by rail to stations near the Coast. There were several cases of what is stated to be cattle plague (rinderpest) and a few cases of anthrax found amongst these cattle on arrival, but severe outbreaks of these diseases never manifested themselves. 25 cattle belonging to herds suspected of cattle plague were seized and isolated during the three months ended 31st March, 1918, of which 18 died from cattle plague while under detention and 7 from pleuropneumonia. Mange or scab appears to have been prevalent among dogs, sheep and goats. Figures are given dealing with the importation and exportation of live stock from Coomassie and the management of the Livestock Farm at this same town.

NORTHERN AND SOUTHERN PROVINCES OF NIGERIA. **Annual Reports on the Agricultural Departments for the Year 1918.**—Report of the Veterinary Department [BRANDT (F.R.), Chief Veterinary Officer.] Northern Provinces. pp. 7–11. f'cap. 1919. Lagos: Govt. Ptr.

The training of natives as Stock Inspectors was the principal work of the Department and there are now 27 trained natives, who when placed under the direction of a Veterinary Officer have proved to be of assistance in discovering the existence and checking the spread of disease. The method of organising a system of veterinary inspection among the native cattlemen is described. For more than two years certain rules have been adopted by the Native Administration to control the spread of contagious disease and at least in those parts traversed by Veterinary Officers, viz., Zaria and Southern Kano, these rules are being enforced by the district headmen in a fairly satisfactory manner. In parts where a Veterinary Officer is not stationed, such as Sokoto and Bauchi, periodical reports are sent in which show that attention is paid to these rules. In herds which are stationary in one place the control of disease is comparatively simple but the annual movement of large herds of cattle away from Kano, North Zaria and Bauchi during the dry season into Southern Zaria and Nassarawa, and their return for the wet season renders efficient control exceedingly difficult. Efforts at controlling disease were concentrated mostly on the Zaria Province owing to the shortage of Veterinary Officers.

During the earlier part of the year several outbreaks of rinderpest were reported by natives in Zaria Province and in Kano. A few reports of this disease were received from other Provinces. It is stated that as the result of the comparatively serious outbreaks in 1915 and 1916 a very large number of cattle has probably become immune to the disease, but in young stock born since then there may be little or no resistance. [Compare in this connection the experience

gained by French Veterinary Officers during the outbreaks of rinderpest which raged through West Africa in these years—this *Bulletin*, preceding No., p. 59.]

Native cattle owners do not pay much attention to a disease which affects only a small percentage of their herd and it is quite likely that rinderpest is being kept alive in many herds without being reported. No attempt at inoculation has been made and the adoption of such a procedure is not generally recommended until thorough tests can be made of the anti-rinderpest serum, and infected animals known to be free from trypanosomiasis are procurable in order to obtain blood for active immunisation.

It appears that contagious bovine pleuro-pneumonia is the cause of a heavy annual mortality throughout the country. For the present the native method of inoculation against the disease by inoculation into the face is not to be discouraged as it tends to curtail outbreaks and animals which recover from its effects have a considerable degree of immunity. The slaughter of all infected or apparently recovered animals is advised.

Foot-and-mouth disease is fairly prevalent throughout the territory but except by diminishing the milk yield in infected animals it does not seem to occasion much disturbance.

With regard to trypanosomiasis it is stated that the definite location of the various fly-belts will take many years to accomplish. In addition to the known tsetse-infested areas in Sokoto, Kano, Bauchi, and Bornu, most of the country south of a line drawn east and west from about 20 miles south of Zaria must be regarded as probably fly-infested, especially during the rainy season. Trypanosomes of the *vivax* type were found in the blood of affected cattle in this part of the country. Two outbreaks occurred in Northern Zaria in herds of cattle which had not been moved away for the dry season, but animals had occasionally been introduced from other districts. In one of these districts careful search was made for tsetse flies, with negative results. The transmission in this outbreak would apparently be due to such biting flies as Stomoxys, Tabanidae, and Haematopota.

An outbreak of haemorrhagic septicaemia occurred in the Borum Province; bi-polar bacilli were found in the blood of affected cattle. The existence of other diseases such as blackquarter, anthrax, and piroplasmosis is suspected but their presence has not yet been confirmed.

Among sheep and goats the only conditions mentioned are those due to intestinal parasites. A number of sheep taken to Kaduna were found to be badly affected with *Haemonchus contortus*; some goats running with these sheep were badly infested with tape-worms.

Epizootic lymphangitis in horses is widespread and it is attributed chiefly to the carelessness of native owners. The type of disease is said to be mild compared with that occurring in other parts of Africa and spontaneous recovery is not unknown. Trypanosomiasis occurs in horses as in cattle.

The impossibility of dealing adequately with contagious disease in a country some 250,000 square miles in extent and containing over 3,500,000 head of cattle with a staff of two Veterinary Officers and a number of unreliable natives is pointed out.

SOUTHERN RHODESIA. **Report of the Chief Veterinary Surgeon for the Year 1918. (With Report of the Veterinary Bacteriologist.)** [SINCLAIR (J. M.), Chief Veterinary Surgeon; BEVAN (Ll. E. W.), Govt. Vet. Bacteriologist.]—7 pp. f'cap. 1919. Salisbury, Rhodesia: Govt. Ptr.

East Coast Fever.—The number of fresh outbreaks during the year was five, with a mortality of 374 head, as compared with 13 and 438 respectively during the previous year. Four of these fresh outbreaks occurred in the Victoria District and were expansions from existing centres of infection; the fifth was in the Shamva section of the Mazoe District, an area not at any time previously affected with the disease. Generally, the position is regarded as more favourable than for many years past, and the congregation at Odzi by road and rail of about 12,000 head of cattle purchased by the Imperial Government in all parts of the territory without a single case of East Coast Fever or other infective disease is considered evidence of the health of cattle in general and also of the efficacy of the quarantine regulations in force and the control of cattle movements by the permit system.

Cattle Cleansing Ordinance 1918.—The Draft Cattle Cleansing Ordinance, recommended by the Committee of Enquiry on East Coast Fever which sat in 1917 [see this *Bulletin*, 1918. Vol. 6. No. 1. p. 46] was passed by the Legislative Council with certain amendments suggested by the Agricultural Union. This Ordinance, which repealed the Compulsory Dipping Ordinance, 1917, was promulgated in September and thereupon became operative in all areas in which the provisions of the latter had been applied. Provision exists for its application to the remaining portions of the territory and as circumstances permit it is intended to apply it to these areas. [See also this *Bulletin*, 1919. Vol. 7. No. 4. p. 184.] During the year the number of dipping tanks was increased by upwards of 265, the total number now being 1,263. Arrangements were made for the construction of a large number of tanks on native reserves and unalienated land.

Gall-Sickness in Cattle. A considerable mortality, in young stock chiefly, occurred from gall-sickness (anaplasmosis) on farms where dipping had been practised for a number of years, and stockowners were apprehensive lest this should become a seasonal occurrence if regular and proper dipping were maintained. Dipping undoubtedly prevents the establishment of that degree of immunity against gall sickness and redwater which is necessary to protect cattle when exposed to free tick infestation. When stock contract gall-sickness and die on farms where dipping has been regularly carried out for a number of years the position is admittedly serious and one is naturally led to enquire as to the effectiveness of the dipping on the farms where this mortality occurred. On several of the farms on which the mortality referred to occurred it is admitted that ticks had increased enormously during the latter part of the year. It is thus reasonable to assign the mortality from gall-sickness in these instances to dipping in solutions of ineffective strength.

Blackquarter.—In Bulawayo and adjoining districts this disease has assumed the character of an enzootic. In this part it is rare for any but young animals to contract the disease in herds which were infected

in the previous year, but in newly infected herds a small percentage of mature animals contract the disease and die. The disease appears to be slowly spreading eastwards. The total mortality recorded was 1,104 head, as compared with 1,335 the previous year.

Anthrax.—Four outbreaks in cattle were dealt with, viz., one in the Mtoko district, two in the Makoni district, and one in the Hartley district.

One case of bovine tuberculosis was detected at the Bulawayo abattoir and one was reported from the Gwanda district.

At the Johannesburg abattoirs 14 cases were found on post-mortem inspection of 12,132 head of slaughter stock exported from the Territory. Tuberculosis was found in one goat at the Bulawayo abattoir.

A number of fresh centres of contagious abortion in cattle were discovered and it is thought probable that the disease exists to a much greater extent throughout the Territory than has been suspected.

The total mortality from horse-sickness was 161 horses and mules, mostly horses. No statistics were available in several districts, simply a general statement that a heavy mortality occurred. The degree of infection during the season must therefore have been heavy.

Owing to the extension of the tsetse fly belt towards Malindi in the Wankie district a number of fatal cases of trypanosomiasis in cattle occurred. A slight mortality in cattle occurred in the Hartley and Melsetter districts. In the latter case the tsetse was not found in the district but it is known to exist in Portuguese Territory close to the boundary [see also this *Bulletin* this No. p. 115].

Ephemeral fever or three-days sickness of cattle was prevalent during the months of March and April but it caused hardly any mortality. No case of glanders occurred.

Owing to the efforts of the Rinderpest Commission the southward extension of rinderpest from Central Africa appears to have been definitely stayed.

Report of the Veterinary Bacteriologist. Routine work at the laboratory consisted in the diagnosis of contagious abortion by means of the agglutination test, the preparation of live vaccines against this disease, and examination of smears. Although many smears from sick and dead animals have been examined at the laboratory during the last fourteen years no preparation showing the anthrax bacillus was received until July 1917, and even since then the distribution of the disease has been very limited. A few outbreaks of trypanosomiasis were detected and many hundreds of doses of arsenic-antimony injection were issued, with, it is stated, very satisfactory results. The treatment, however, did not effect a cure, but it enabled a large proportion of animals to acquire a tolerance to the trypanosome comparable with that produced in cattle and dogs towards piroplasmosis after treatment with trypanblue. Since the commencement of the wet season a very large number of smears were received from all parts of the country from cattle suffering from an acute form of anaplasmosis. The great majority were taken from animals of "improved" types bred upon farms where systematic dipping had been practised for some years. It would appear that the supposed eradication of ticks had given rise to a false sense of security and led to carelessness and finally losses.

Experimental work was restricted almost entirely to the inoculation of horses against horse-sickness by a method devised by Bevan himself. Two out of 12 horses that were inoculated died but the remaining 10 were immunised. Towards the end of the year it was decided to issue to the public vaccine for the inoculation of young horses under two years of age. Breeders of horses who in previous years have placed foals at Bevan's disposal for experimental purposes and have submitted treated animals to natural infection expressed complete confidence in the method. Some difficulty was experienced in the application of THEILER'S method of inoculating mules, and so 12 young mules were submitted to Bevan's method of inoculation, with such satisfactory results that further experiments appear to be justified. During the past horse-sickness season, which, at the commencement, was exceptionally severe, only five deaths occurred among the 150 Police horses previously inoculated and distributed throughout the country; in several districts these Police horses were practically the only equines that survived. The five deaths occurred in one district only; in all other districts although several animals became re-infected the immunity held good, and after a mild reaction they recovered.

A few details concerning a new veterinary inoculation station which is in course of construction are then given.

NYASALAND PROTECTORATE. **Annual Report Department of Agriculture for the Year ended 31st March 1919.** [Report Veterinary Division (DE MEZA J.) Acting Senior Veterinary Officer.] pp. 7–8. f'cap. 1919. Zomba: Govt. Ptr.

For the greater part of the year the Veterinary Officer in Zomba (at the southern end of the Protectorate) was chiefly concerned with supplying meat to the Military Forces in Nyasaland, a task of considerable difficulty as the herds of native cattle had been severely depleted during the preceding two years. Cattle had thus to be brought down from the Mzimba District (towards the north of the Protectorate), but before they were introduced into the district around Zomba they were examined for ticks and passed through a dipping tank. This proved successful in preventing the introduction of East Coast Fever, but high mortality occurred as the result of debility and fatigue due to the hardships of the long journey.

In 1915–1916 all herds in the Zomba and the adjacent Blantyre districts were carefully examined for demodectic mange, and treated when necessary, on account of the importance which this disease had assumed. Since that time it has not been possible to undertake a systematic inspection on account of shortage of staff. However, only an occasional case of the disease is now met with in these Districts. The incidence of this disease in outlying districts is not known but several cases were found in herds brought in from Mzimba. In Southern and Northern Rhodesia it is mentioned that this disease still gives great trouble.

Isolated cases of redwater in cattle occurred in the Shire Highlands, but many planters are now erecting their own dipping tanks and with systematic dipping it is hoped the disease will entirely disappear. Towards the end of the year a disease was observed in calves and sheep caused by an organism resembling a piroplasm.

Isolated outbreaks of trypanosomiasis were reported from all parts of the Shire Highlands and most of the cases were attributed to mechanical transmission by *Tabanidae*. In the Mlanje District the spread of this disease, on the other hand, has become somewhat alarming and there is reason to believe that *Glossina brevipalpis* is of fairly common occurrence in this District.

The situation as regards rinderpest in the North Nyasa District and in the occupied part of "German" East Africa was so effectively dealt with by the South African Rinderpest Commission that this body terminated its labours at the end of March 1919 [see this *Bulletin* 1919. Vol. 7. Nos. 2, 3 & 4. pp. 90, 160, & 244]. The northern Nyasaland border is now being guarded by European lay inspectors and a system of cattle registration is being brought into force whereby the control of native herds is much simplified. The cattle-free belt, from the Stevenson Road to the Northern border, is still being kept as an extra precaution. In November 1918 a suspected outbreak at Ngara proved to be one of tsetse-fly disease.

Few cases of liver fluke disease (in sheep?) were reported on account of the rainfall being far less heavy than in 1917–1918.

Cattle were again considerably troubled with ophthalmia, but it is not believed that the condition is a specific disease and the early application of weak antiseptic lotions prevents serious complications.

No case of rabies was reported.

The mortality among poultry from fowl cholera was not so marked as in the last few years.

Canine piroplasmosis was again prevalent and dog owners are advised to pass their animals through a dipping tank once a week in order to destroy the transmitting tick (*Haemophysalis leachi*). The necessity for the importation of bulls in order to improve the native stock which is of small size and unsuitable for work is emphasised.

UGANDA PROTECTORATE. **Annual Report Department of Agriculture for the Year ended 31st March 1919.**—Report of the Chief Veterinary Officer [HUTCHINS (E.)]. pp. 33–36. f'cap. 1920. Entebbe: Govt. Ptr.

The chief item of interest in this report is a description of the incidence of rinderpest in the Protectorate. [See also p. 112 of this No.]

In the Buganda Province this disease appeared amongst the game in Buruli and Singo early in April, having spread southwards through the game in Bunyoro since the previous July and crossed the Kafu River. Buffalo, bush-pig, bush-buck, cobus-cob, reed-buck, and oribi died in large numbers near this river. Infected buffalo migrated westwards to Bugangadzi and southwards along the Myanja Valley. By the end of May the cattle in this area had become contaminated and in July the disease spread eastwards to the cattle in Bulemezi and in August into Kiadondo, Busiro, and Kiagwe. In September rinderpest spread through the buffalo along the Kitumbi River and later to those along the Mabukazi River in Bwekula and Singo. Up to September the disease was confined to the north of the watershed between the Kafu and Katonga Rivers and only appears to have spread to the south of this line through the buffalo along the Kitumbi and Nabukazi Rivers. In December the disease spread from Bwekula

to Gomba and thence across the Katonga River reaching Buddu, Mawagolo, and Kabula in January ; it was also spread from this source by buffalo to Toro in January.

In Singo, Bwekula, and Bugangadzi the spread of the infection appears to have been mainly due to the movement of game from infected to clean areas, and carcases of game were usually discoverable before the cattle in these areas became infected. In the Masaka District, owing to delay in reporting, very heavy losses were caused amongst the herds of cattle. It is estimated that about 30,000 cattle died from rinderpest in the Buganda Province during the year. 13,193 cattle were inoculated by the simultaneous method in the Mubendi District, 7,303 in the Mengo District, 397 in the Entebbe District, and 976 in the Masaka District. Considerable difficulties were experienced in obtaining reliable virulent blood for the inoculation, and it was necessary to re-inoculate a number of herds which had not reacted. Extremely heavy losses from trypanosomiasis occurred amongst the cattle inoculated at Kasanda in Singo ; a large number became infected with *T. pecorum*, and the greater number died from this disease. The mortality in most of the Inoculation Camps was high and in some they amounted to about 20 per cent. from all causes. The largest proportion of deaths occurred among calves or very old animals belonging to herds infected with rinderpest prior to the inoculation and herds infected with trypanosomiasis.

In the Eastern Province there were numerous outbreaks in several centres and heavy losses were reported, but the disease does not seem to have been dealt with to any great extent on account of the inadequacy of the staff. 2,370 cattle were inoculated in the Lango District, 1,137 in the Teso District, and 360 in the Busoga District.

In the Western Province the disease appears to have been introduced in January by buffalo from Bwekula into the south-eastern part of the Toro District and large numbers of buffalo were reported to have been found dead in areas in which they had not previously been known. As the quarantine regulations were well kept the disease had not, up to the end of March, spread to the cattle outside the original centres of infection. In January the disease was reported in the counties of N'sara and Nyabushozi in Ankole near the Masaka border and very heavy losses resulted.

Outbreaks of trypanosomiasis occurred amongst herds in South Western Singo, in Bugerere, and at Butiaba. Cattle at Kigamere in Buyaga were found to be infected ; *Glossina fusca* was found in this neighbourhood on the Djumambogo River. Herds at Kyabanja, Kiguale, and Kagoro in Toro were also found to be infected.

Several outbreaks of foot-and-mouth disease were reported in Buganda, but this disease was not so prevalent as it had been in recent years.

Pulmonary tuberculosis was discovered in an Ankole cow at the Kampala slaughterhouse.

An outbreak of anthrax was reported at Mbarara ; this disease appears to be of common occurrence in most parts of the Western Province.

Among diseases of equines, mention is only made of two cases of ulcerative lymphangitis treated.

Outbreaks of scab in sheep and goats were not so numerous as in previous years.

Two cases of avian tuberculosis were found in Kampala in fowls that had been imported from British East Africa.

1,035 cattle were exported from the Buganda Province to British East Africa and these included 350 head used for the production of anti-rinderpest serum at Kabete.

The report closes with the returns of the slaughterhouse at Kampala, the results of microscopic examination of slides received at Kampala, cases treated at the veterinary dispensary, and the incidence of disease among Government livestock.

NATIONAL COLLECTION OF TYPE CULTURES.

(Lister Institute, Chelsea Gardens, London, S.W.)

The Medical Research Committee (now the Medical Research Council) have long had in view the formation of a National Collection of Type Cultures, from which biologists in general and bacteriologists in particular may obtain authentic strains of recognized bacteria and protozoa for use in scientific work. The need of an available supply of this kind has long been felt in many directions and particularly in medical research work, for the study of principles and methods in bacteriological technique and for the systematic classification of bacteria and protozoa in their various species and strains.

In the past the needs of workers in this respect have never been fully met. In this country the Lister Institute of Preventive Medicine has for many years assisted bacteriologists both at home and abroad, so far as the resources of its own private collection have permitted, but British workers have been dependent in great part upon the courtesy of scientific colleagues or upon the collections of Institutes in other countries. Before the war the collection at the Pasteur Institute in Paris, maintained by M. Binot, was very helpful to workers here. A collection of type cultures was formerly maintained on a commercial basis by Král at Prague, and this was subsequently transferred to the Sero-physiological Institute of Vienna. This source of supply was never completely satisfactory, though many made use of it. In America the Museum of Natural History in New York has maintained a Culture Bureau during the last eight years, and it is believed that the activities of the Bureau have been of the greatest benefit to workers there, not only by the provision of authentic cultures, but also by the studies in classification made by its staff. Early in the present year the Medical Research Council were able, by the courtesy of the Governing Body of the Lister Institute, to make arrangements to maintain a National Collection of Type Cultures at the Institute, where all the necessary facilities have been provided. The scheme will be under the general direction, on behalf of the Council, of Dr. J. C. G. Ledingham, a member of the staff of the Lister Institute, while Dr. R. St. John Brooks and Miss M. Rhodes have been appointed by the Council to be Curator and Assistant Curator respectively. The Medical Research Council are greatly indebted to the Governing Body for this opportunity of establishing a central collection upon a proper footing at once, without further delay. The present arrangement is made for a short term of years, before the end of which the future location of the collection will be considered.

It is proposed to collect and maintain bacterial and protozoal strains of medical, veterinary, and economic importance, but in the immediate future the efforts of the staff will be directed more particularly to obtaining fully authenticated strains of pathogenic organisms.

Subsidiary researches on the viability of bacteria in artificial media will be undertaken with a view to the discovery of economical and labour-saving methods of sub-culture. The staff will also be prepared to give help in the identification and classification of strains received from workers at home or abroad.

The co-operation of bacteriologists is earnestly invited, and in return every effort will be made to supply the needs of applicants for cultures. Cultures that may be sent either for identification or for maintenance in the collection should be accompanied by the fullest particulars as to source and date of isolation and, if possible, by clinical and epidemiological notes. It must naturally be left to the discretion of the Director to decide whether given cultures are of sufficient importance to be maintained in the collection, but it is hoped that this will not deter workers from forwarding strains of even the commonest types of organism. These will have value at least for the adequate representation of strains of recent origin. Studies in classification will also be aided if large series of authentic specimens of closely related species are available for workers.

Cultures will be supplied on demand so far as possible to workers at home or abroad and, as a rule, a small charge will be made to defray the cost of media and postage. Strains representing at least the commoner types of human infection can already be supplied, and at a later date it is proposed to prepare a catalogue for publication.